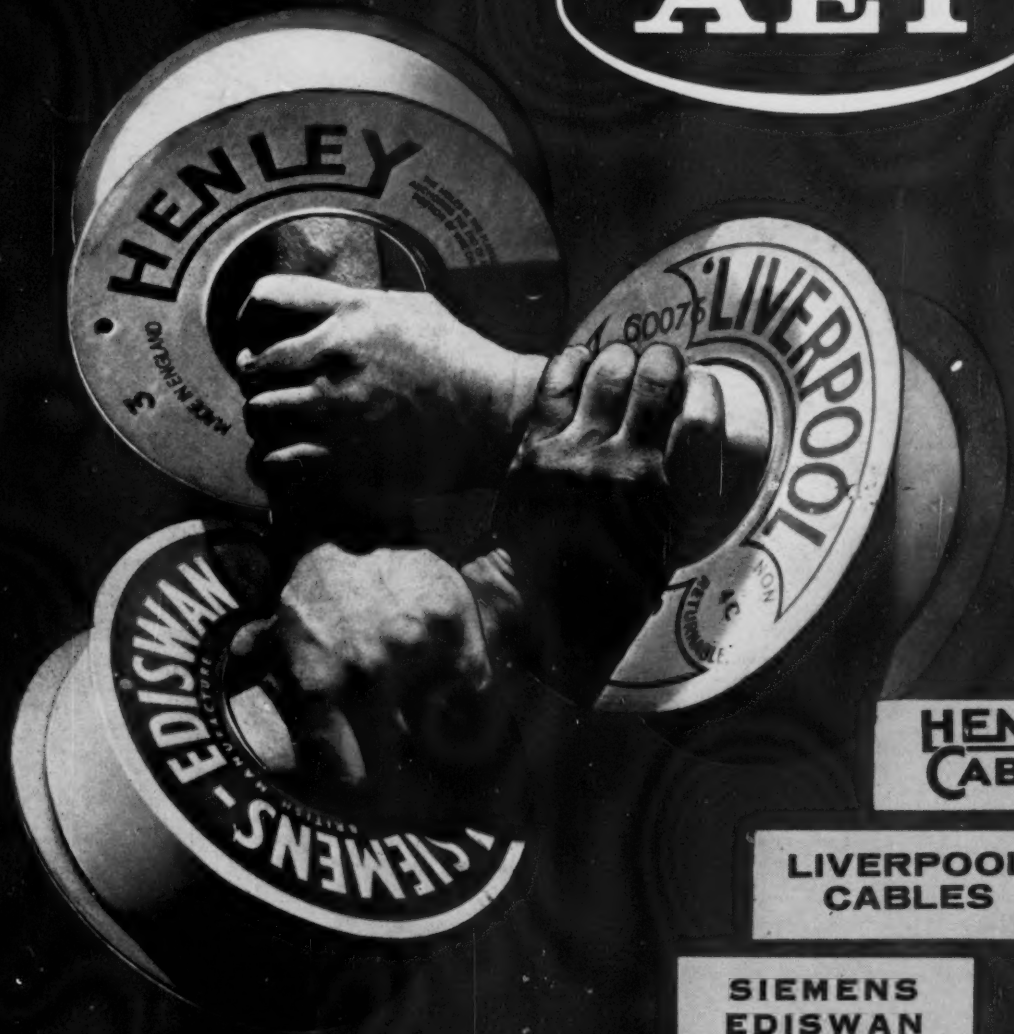
ELECTRICAL TIMES

AEI



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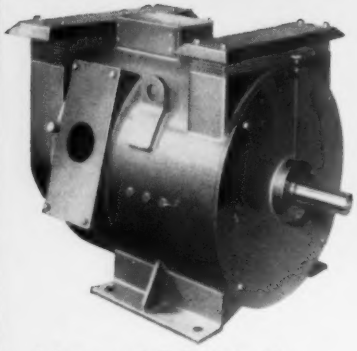
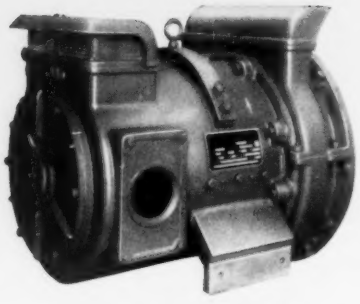
POWER AND CONTROL

E.D.C.C. make Motors, Generators and Starters for all marine purposes, in standard and special designs.

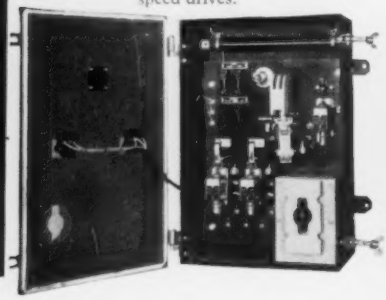


60 h.p. 220 volt D.C. Marine Motor, drip-proof enclosure.

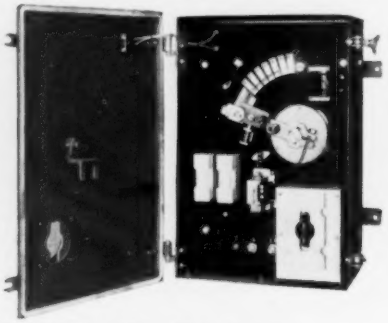


35 kW. 220 volt D.C. Marine Generator, flange mounted for coupling to diesel engine.

Contactor Starter for D.C. motors available for constant and variable speed drives.



Hand operated Faceplate Starter for D.C. motors, available for constant and variable speed drives.



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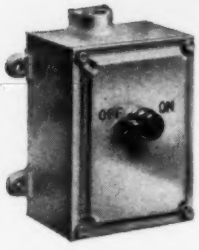
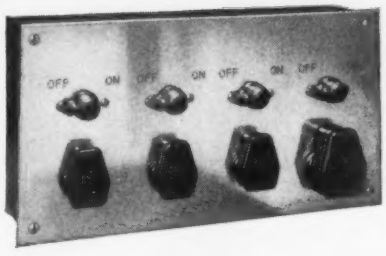
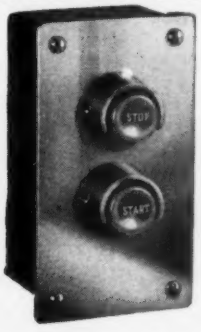
P.4282

Walsall





SPARKLESS UNITS FOR SAFETY



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We manufacture all types of Stator and Rotor Starters for controlling Slip Ring Motors, both of the hand operated, oil immersed or liquid starter type and also the contactor type. Typical examples are illustrated.

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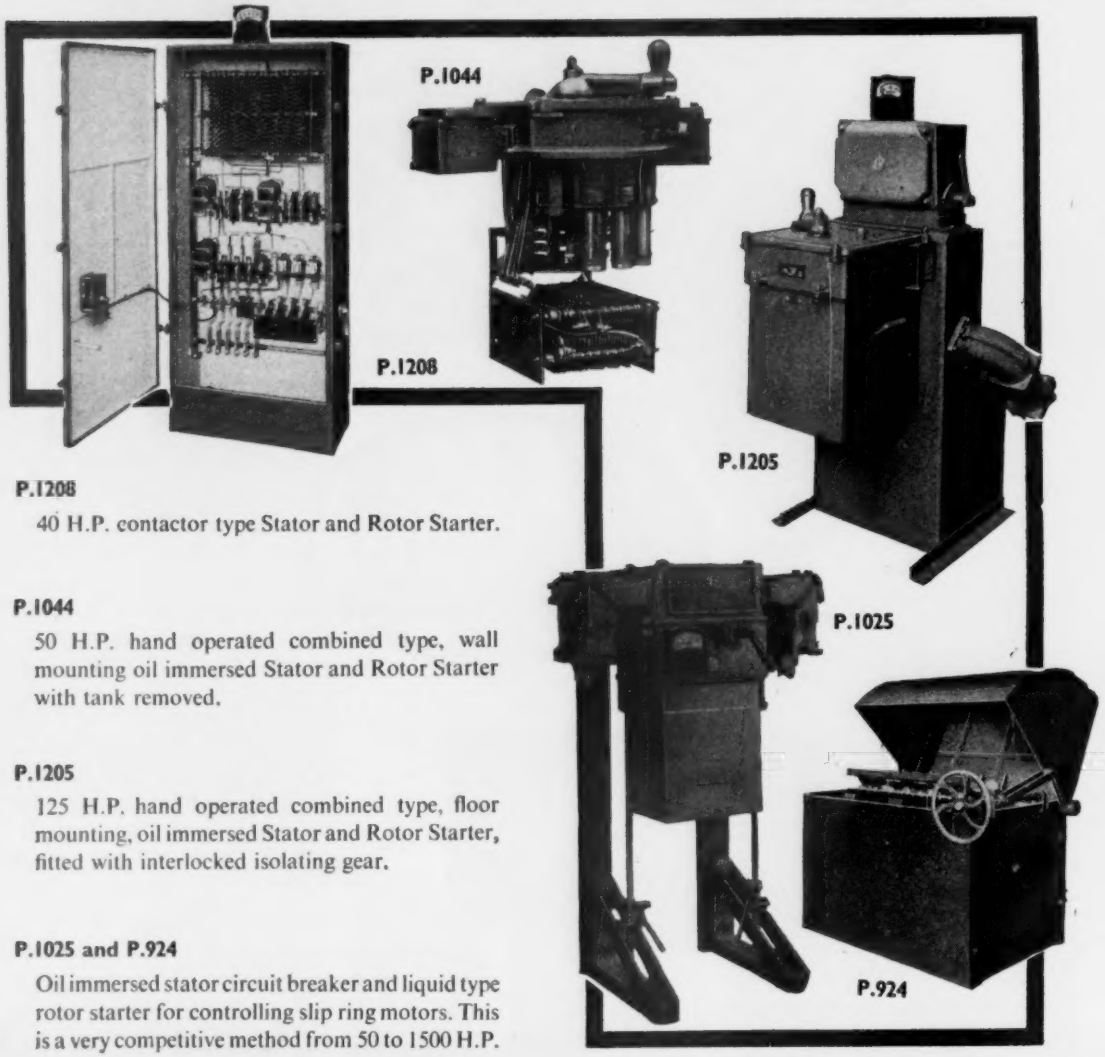

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40 H.P. contactor type Stator and Rotor Starter.

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50 H.P. hand operated combined type, wall mounting oil immersed Stator and Rotor Starter with tank removed.

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125 H.P. hand operated combined type, floor mounting, oil immersed Stator and Rotor Starter, fitted with interlocked isolating gear.

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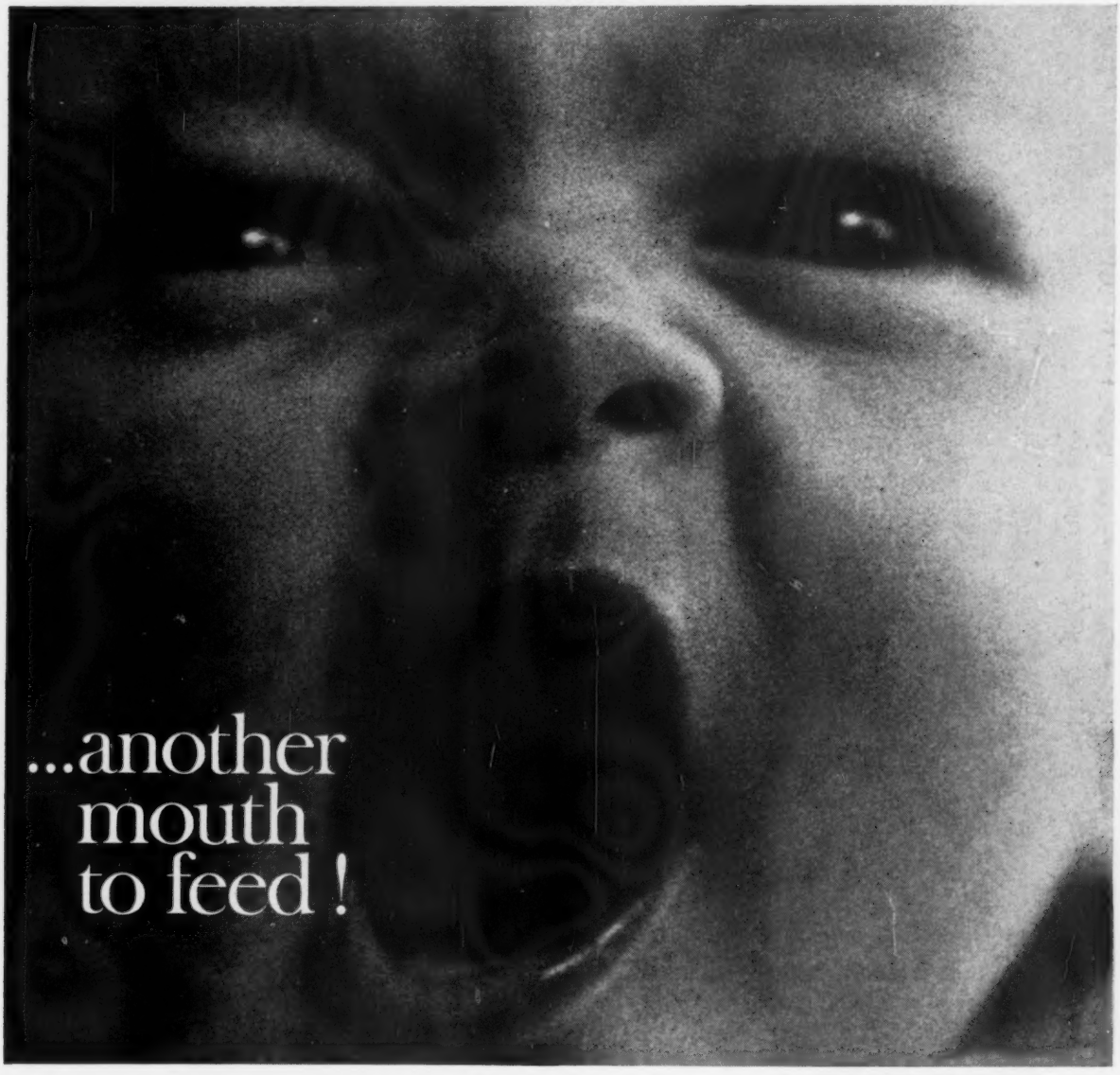

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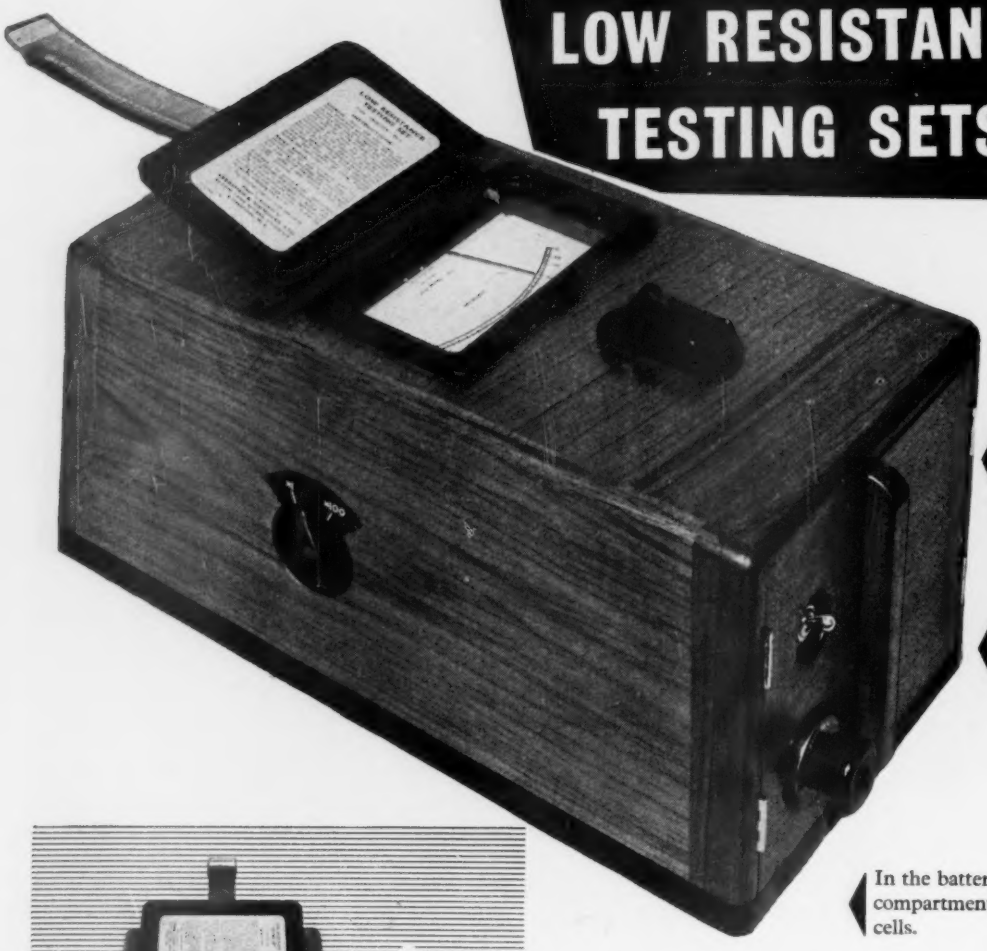
TRADE MARK

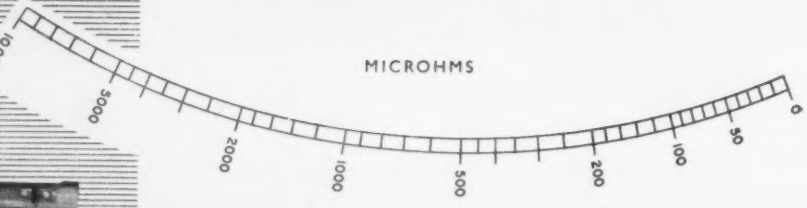
LOW RESISTANCE TESTING SETS



Mains operated instrument. A similar battery operated instrument also available.

Compartment for leads and testing spikes.

In the battery model, this compartment contains 2 alkaline cells.



An entirely new, self-contained, direct reading testing instrument having a range of measurement from:

10 microhms to 1 ohm

provided by a 2-position switch (x 1, x 100).

Size 16¼ x 8½ x 8½ ins. Weight 26½ lb.

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Smaller, more compact 'C' type motors are easier to handle, they fit well into the small space you can allocate for them on new machines. They cost less to buy—a worthwhile consideration when every penny you can save on your product helps to keep it competitive. For convincing proof write for List 890 . . . or telephone your nearest Brook Sales Office for free technical advice.

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Industrial Plugs and Sockets

figure in **PLAYTEX** *production*

Photographs by courtesy of Messrs. Playtex, Port Glasgow.

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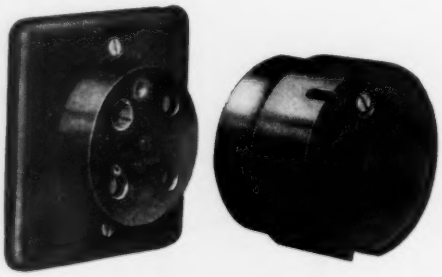
The 'PLAYTEX' factory at Port Glasgow supplies Great Britain and many overseas areas—a commitment which demands continuous flow line production. That is why, in the Sewing Department handling underwear and babywear, the power take-off to each of up to 200 sewing machines is entrusted to D.S. industrial type plugs and sockets, to ensure a power supply that is continuous, safe and convenient.

You too can eliminate hold-ups in *your* production line with D.S. Industrial Plugs and Sockets.



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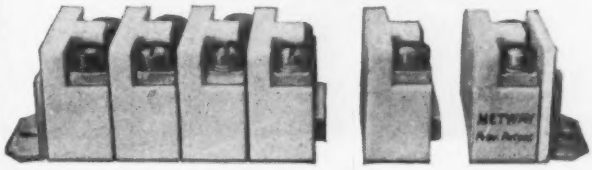
SOLVE YOUR CONNECTION PROBLEMS

"BUILDWAY"
INTERLOCKING TERMINAL BLOCK



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The "BUILDWAY" Blocks are the latest addition to the Metway range. Single units of heat resisting steatite interlock enabling Terminal assemblies of any number of ways to be built up, rated up to 20 amps, 500 volts.

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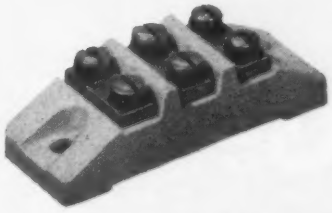

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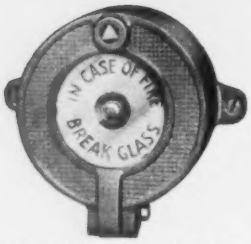

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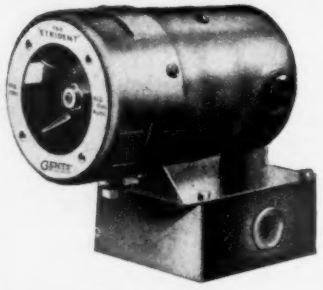
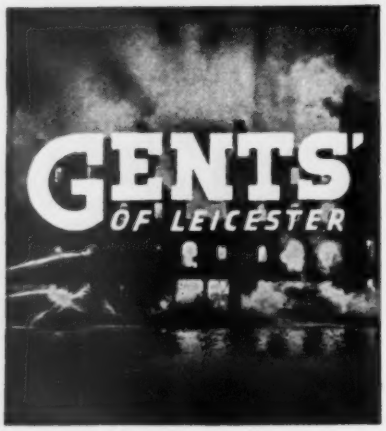


The "STRIDENT" Syren

Alarms



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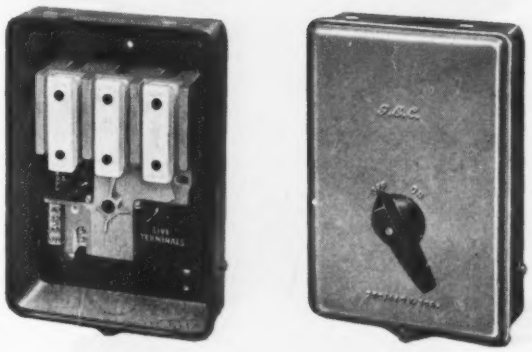
Men whose business it is to assess and advise are quick to appreciate the very real advantages offered by G.E.C.'s new Hidutac switchfuses. Unlimited full load switching. High breaking capacity. High fault current protection. Absolute safety. These are the performance features that the experts like so much, but they also welcome the smaller size and the good looks of this advanced range of switchfuses. As it is made by G.E.C., they naturally take its reliability for granted.



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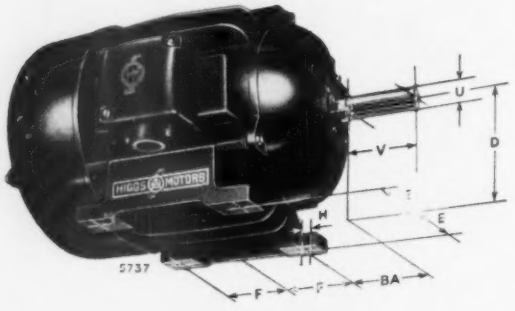

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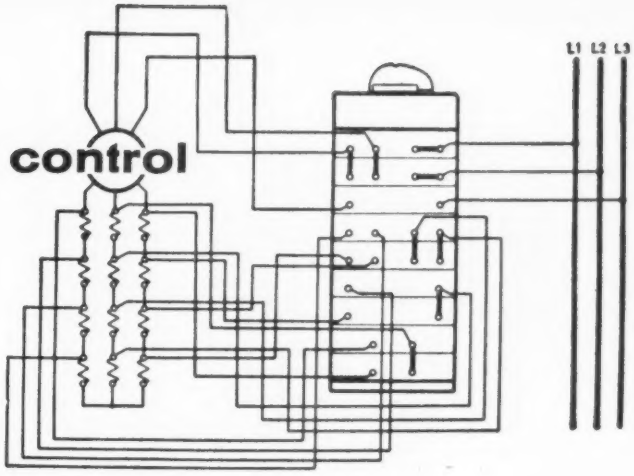
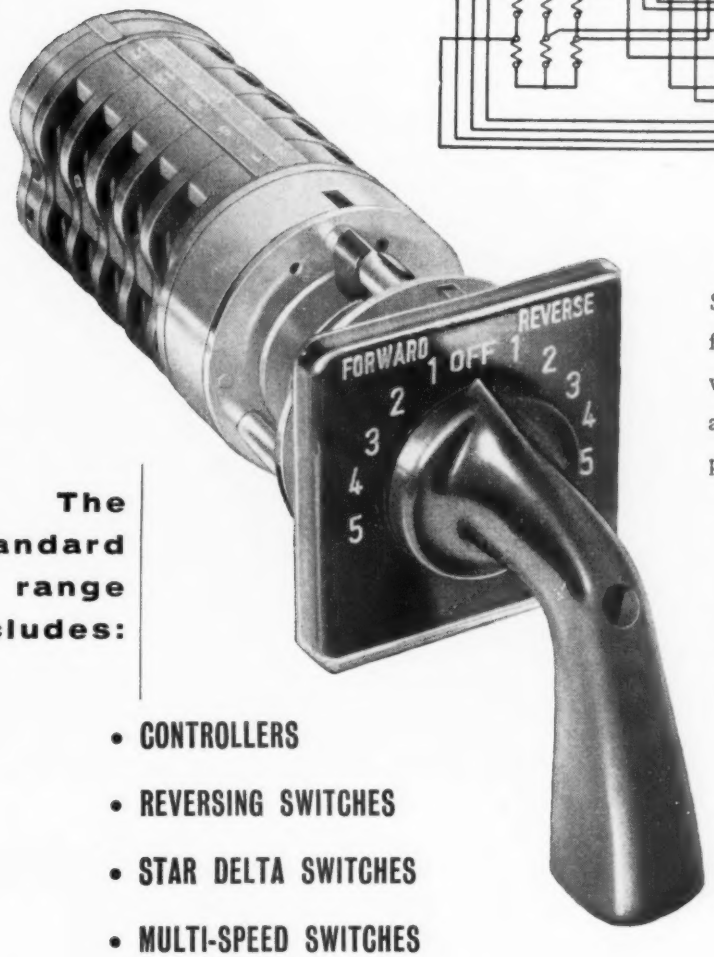
Ratings h.p. Rev./min. Syn. speed at 50 c/s supply				Frame Size	D	E	F	BA	H	U	V	Key		AVAILABILITY
3000	1500	1000	750									Width	Thick-ness	
1½	1	½	—	D162	4	3⅛	2	2⅜	⅜	⅜	2⅛	3/16	3/16	NOW
2	1½	¾	½	D164	4	3⅛	2½	2⅜	⅜	⅜	2⅛	3/16	3/16	
3	2	1	¾	D182	4½	3⅛	2½	2⅜	7/16	1⅛	3	5/16	¼	
5	3	2&1½	1	D184	4½	3⅛	2½	2⅜	7/16	1⅛	3	5/16	¼	
7½	5	3	2&1½	D213	5½	4½	2⅞	3½	7/16	1⅜	3⅜	¼	¼	SHORTLY
10	7½	5	3	D215	5½	4½	3½	3½	7/16	1⅜	3⅜	¼	¼	
15	10	7½	5	D254	6½	5	4¼	4½	9/16	1⅝	4⅜	7/16	5/16	
20	15	10	7½	D256	6½	5	5	4½	9/16	1⅝	4⅜	7/16	5/16	
25	20	—	10	D284	7	5½	4⅝	4½	9/16	1⅝	5⅛	¼	5/16	
30	25	15	—	D286	7	5½	5½	4½	9/16	1⅝	5⅛	¼	5/16	
	30	20	15	D324	8	6½	5½	5½	11/16	2⅛	6⅛	⅜	7/16	
	40	25	20	D326	8	6½	6	5½	11/16	2⅛	6⅛	⅜	7/16	

Everything under control





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5-speed, reversing control switch for a hoist motor, spring loaded so that the handle returns to 'off' immediately on release.

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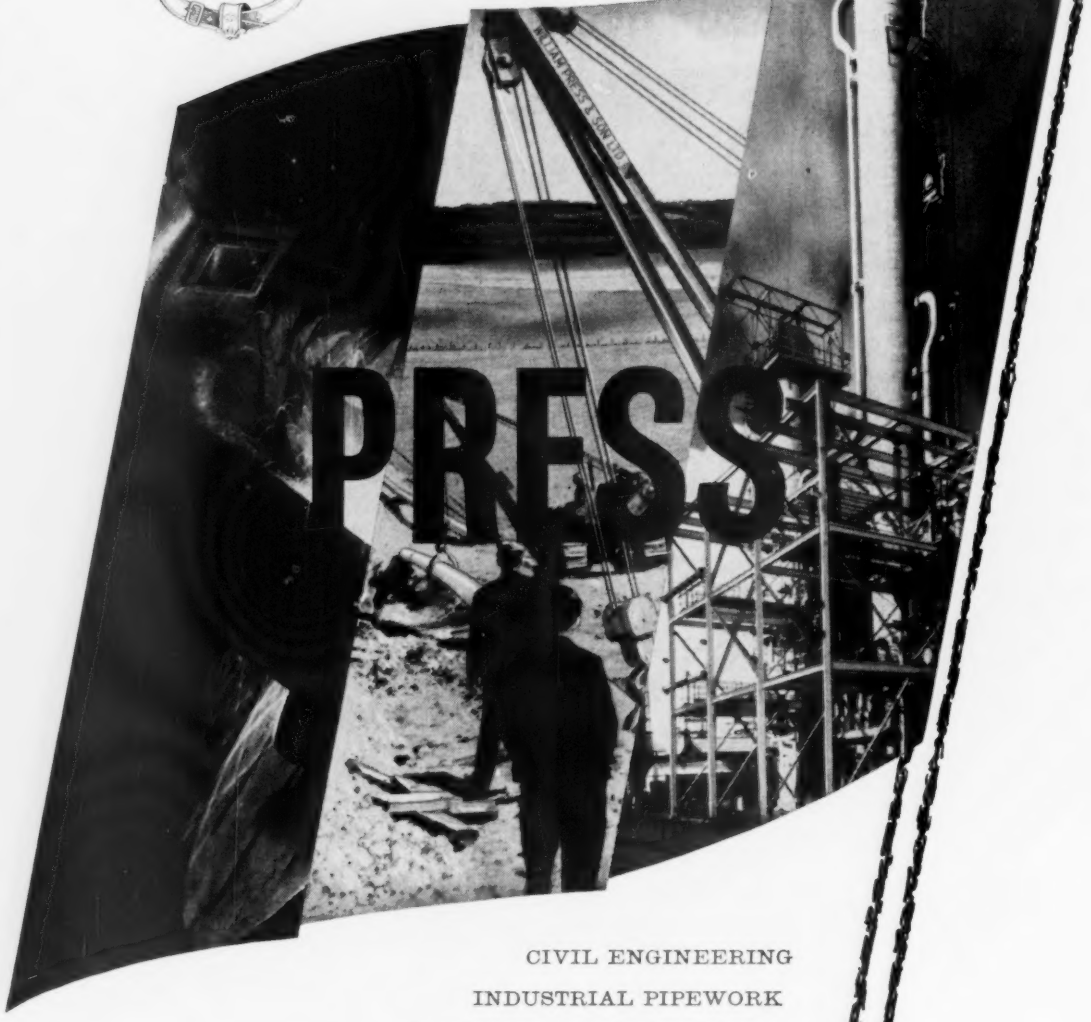

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Radiant, reheat units, pulverized-fuel-fired, for WEST THURROCK power station.

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Radiant, reheat units, pulverized-fuel-fired, for WEST THURROCK, WILLINGTON 'B', KINCARDINE and HAZELWOOD (Australia) power stations.

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Radiant units (four with reheat) pulverized-fuel or 'Cyclone' fired, of capacities from 100 to 120 MW, for BLYTH 'A', RUGELEY, USKMOUTH 'B', PADIHAM 'B', FERRYBRIDGE 'B', ASNAES (Denmark), PONT BRULE (Belgium); and also the six 100 MW units at CASTLE DONINGTON power station, which topped the efficiency table in 1959.

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Only Square D has ONE-PIECE Construction. ONE-PIECE construction eliminates any possibility of heater misalignment. Square D melting alloy thermal overload relays can be installed only one way. They are tamper-proof. They are factory-assembled, are individually calibrated and tested. Repeated tripping will not affect accuracy.

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...BE SURE YOU GET IT!

Heat-responsive element *(solder pot) provides accurate response to overload, yet prevents nuisance tripping.*

Heat producing element *is an integral part of overload unit. It's permanently joined to solder pot, can't become misaligned.*

Individual factory inspection *of every Square D melting alloy thermal overload relay means performance you can trust. Each unit is calibrated and thoroughly tested to make sure it will perform according to its rating.*

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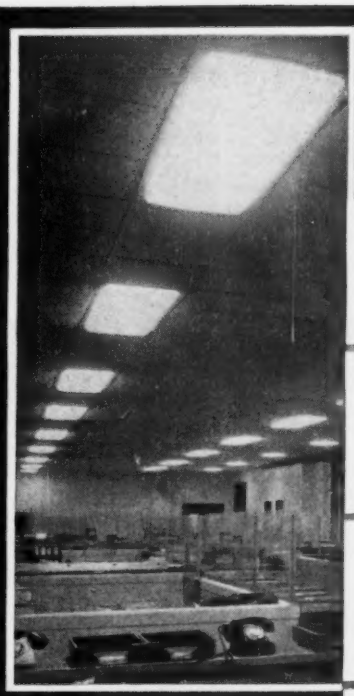
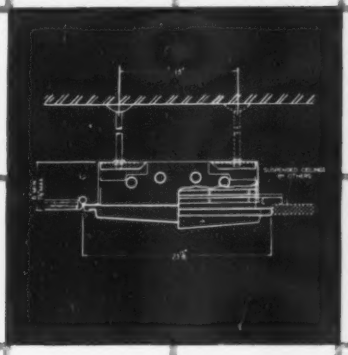




first-time fit for 'modular' ceilings

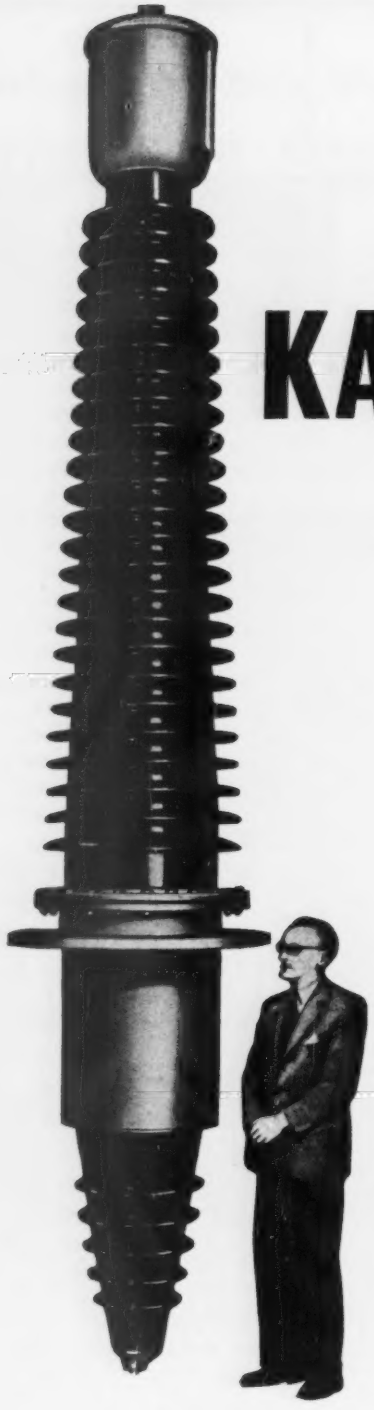
The main objections to 'modular' lighting have been the difficulties of wiring, accurately positioning downdrops, cutting apertures and packing cavities, and the disproportionately high costs because of the 'special' nature of the lighting. Here then is the answer to all those problems, the new **atlas modulite** recessed troffer fittings, a range designed to fit quickly and neatly into *any standard suspended ceiling*. These high quality fluorescent fittings provide adequate lateral and vertical adjustment, allowing complete pre-wiring and beautifully neat finishing. Based on a 1ft. or 2ft. module, **atlas modulite** is available in 2ft., 4ft. and 6ft. lengths, with an additional 2ft. section to give local tungsten spotlighting where required. With a further choice of diffusers, **atlas modulite** provides wide scope for variations of lighting, and allows continuous runs of fittings or 'pattern' arrangements. The result is simpler installation and maintenance, high operating efficiency, and exceptionally attractive appearance.

atlas modulite

pre-fit fluorescent for modular ceilings

Atlas Lighting Limited, Thorn House, Upper St. Martin's Lane, London, W.C.2

PPV A275



KARIBA at 330 kV.

All the bushing porcelains for the 330 kV. circuit breakers
All the 330 kV. strain insulators for the substations
and the 330 kV. post insulators for some of the substations
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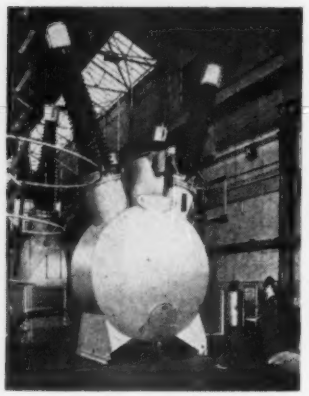

The illustrations show a complete 330 kV. bushing insulator and a 330 kV. circuit breaker, by courtesy of the B.T.H. Co.

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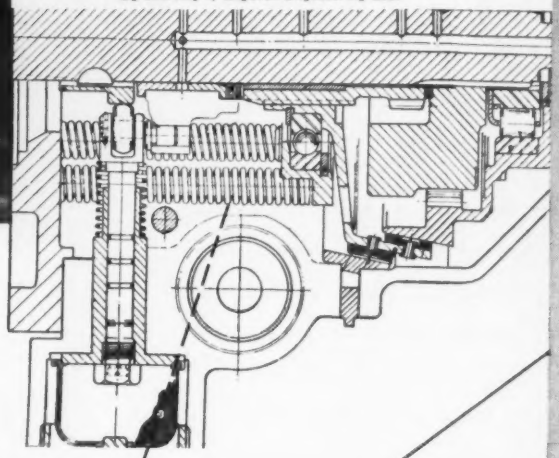

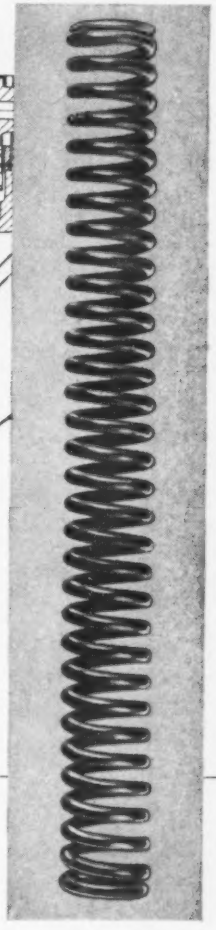

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The applications for SALTER springs are wide and varied — from heavy machinery to finely balanced instruments.

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Expamet-Cressall resistors, rheostats and heaters form the most comprehensive range available from a single source and units to control loads from 4 watts to over 20,000 Kilowatts have already been supplied. The introduction of new designs of associated equipment widens still further the enormous field of applications of Expamet-Cressall products. Further details and technical advice from our engineers is freely available.

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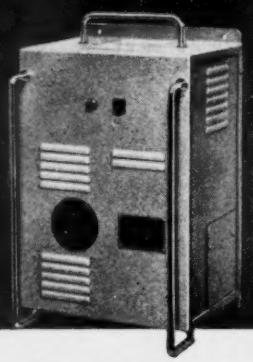
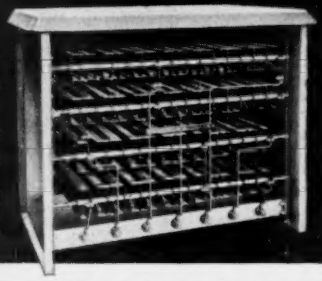
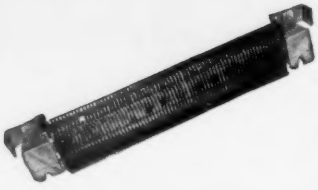


A range of A.C. Mains Voltage Stabilisers has been developed which incorporate electronic detector systems of new design, and are robust, reliable and very compact.

Torovolts are new toroidally wound continuously variable auto-transformers. Electrical and mechanical improvements give greater safety and reliability. Legible dials give maximum convenience in use.



"Expamet" expanded metal resistors are able to dissipate heavy electrical loads efficiently through long continuous service.



The "Edgemet" edge-wound strip type resistor for confined space and high temperature conditions.

A NEW RANGE OF INSTRUMENTS

EASIER TO READ . . .

FROM ANY ANGLE . . .

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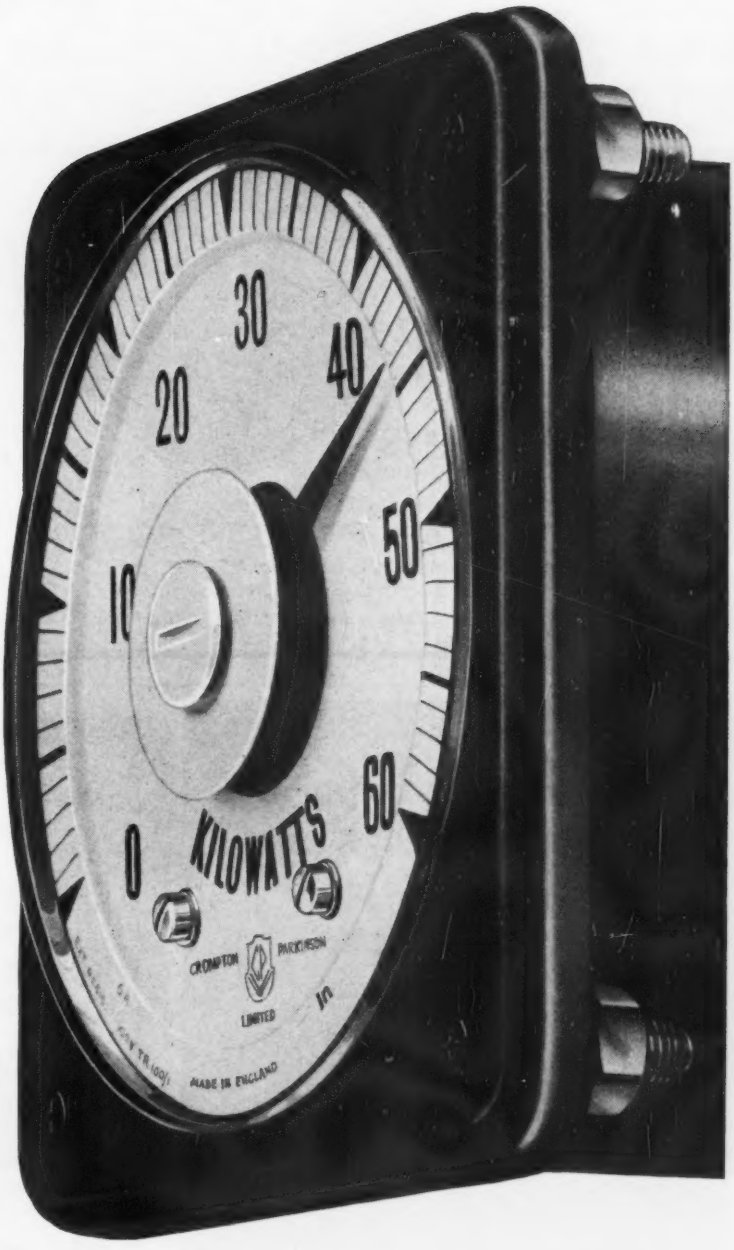
'NEW-WORLD'



This is what the dial looks like at 60° from the centre line – it can obviously be clearly read over a total angle of 120°: just one advantage of the front-line scale and contoured window of Crompton Parkinson 'New-World' instruments.

Shadow-free dial – scale is level with front of bezel and forward of panel.

Less reflection glare – glass contours minimise 'flashing' from adjacent light sources.

No light striations – glass rim has minimum lens effect – no break-up of transmitted light.

Long clear scale – 6½ in. scale on 3½ in. dia. platform dial. Bold cardinals and figuring ensure speedy no-error readings.

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Full range – Ammeters and Voltmeters, moving-iron and moving-coil; Wattmeters: Frequency, Speed, and Power-Factor Indicators: Rotary Synchroscopes.

'New-World' instruments embody many Western-hemisphere design features. Your product will have increased acceptance in dollar markets if it carries 'New-World' instruments.

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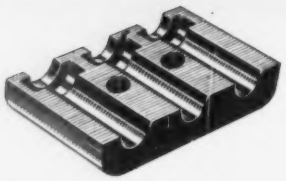
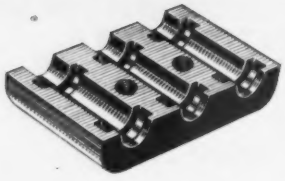
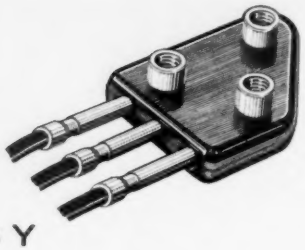

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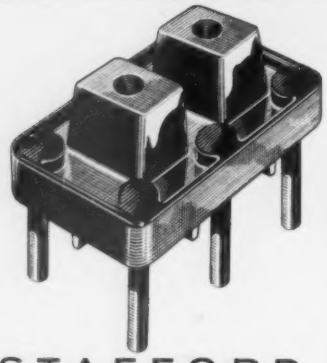
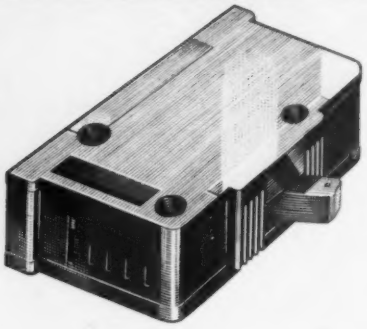

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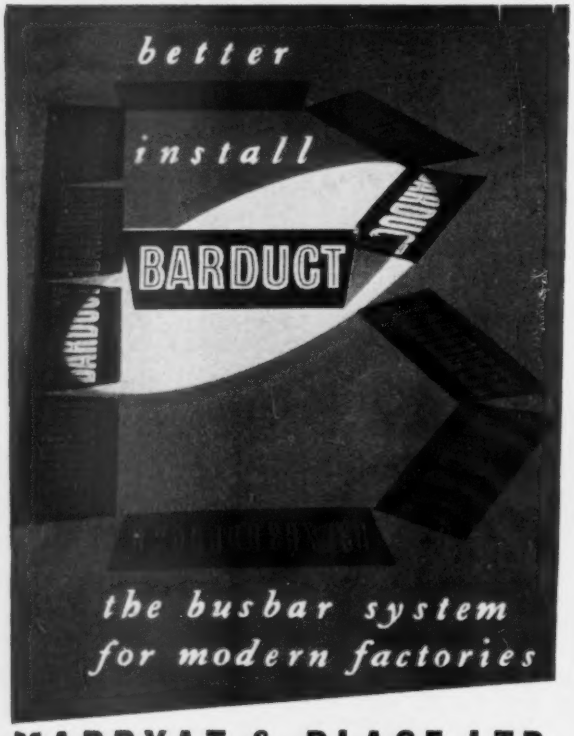

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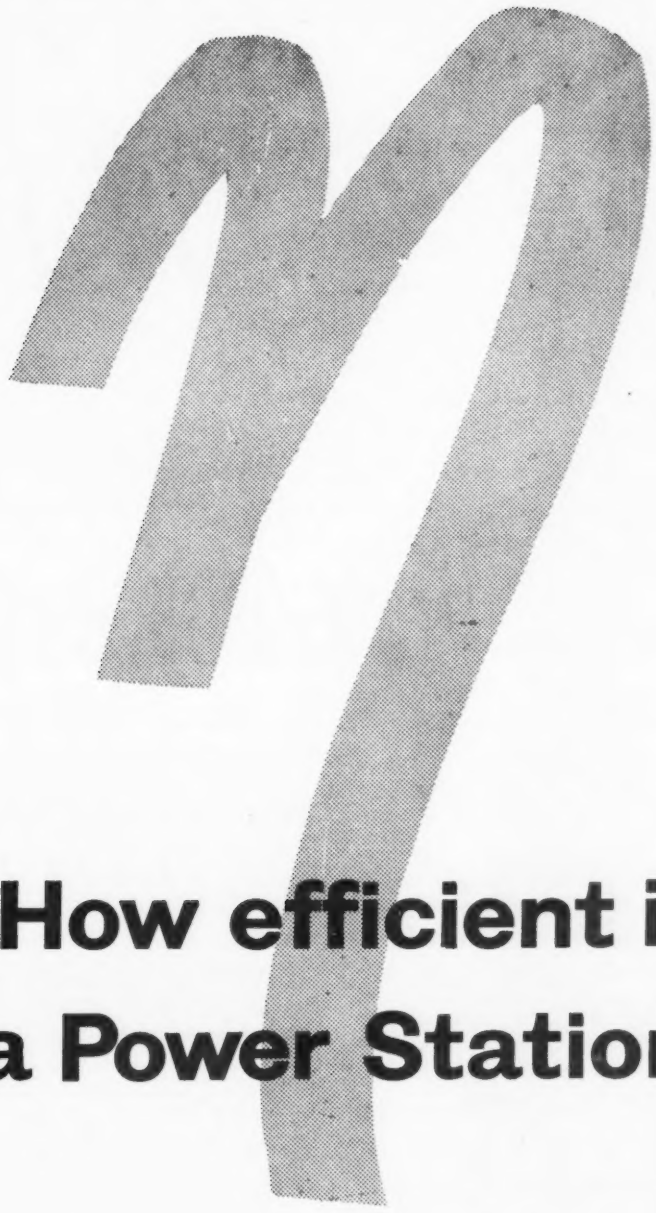

How efficient is a Power Station?

The term 'efficient' is often used loosely as an alternative to 'effective'. In Electricity Supply, however, the 'efficiency' of a power station has a well-defined and exact connotation. It indicates the heat energy expended to produce a unit of electricity.

Progressively, new power stations are more 'efficient' than their predecessors — they burn less coal for a given output. The engineers of the Central Electricity Generating Board are producing designs which, by increasing efficiency, enable power stations to offset substantially the rising costs of materials.

In spite of increased efficiency, however, the available supply of suitable coal cannot long keep pace with the demand for electricity, which doubles every decade. The gap that threatens in the not distant future will now be filled by the rapidly expanding nuclear power programme.

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NEWS SHEET

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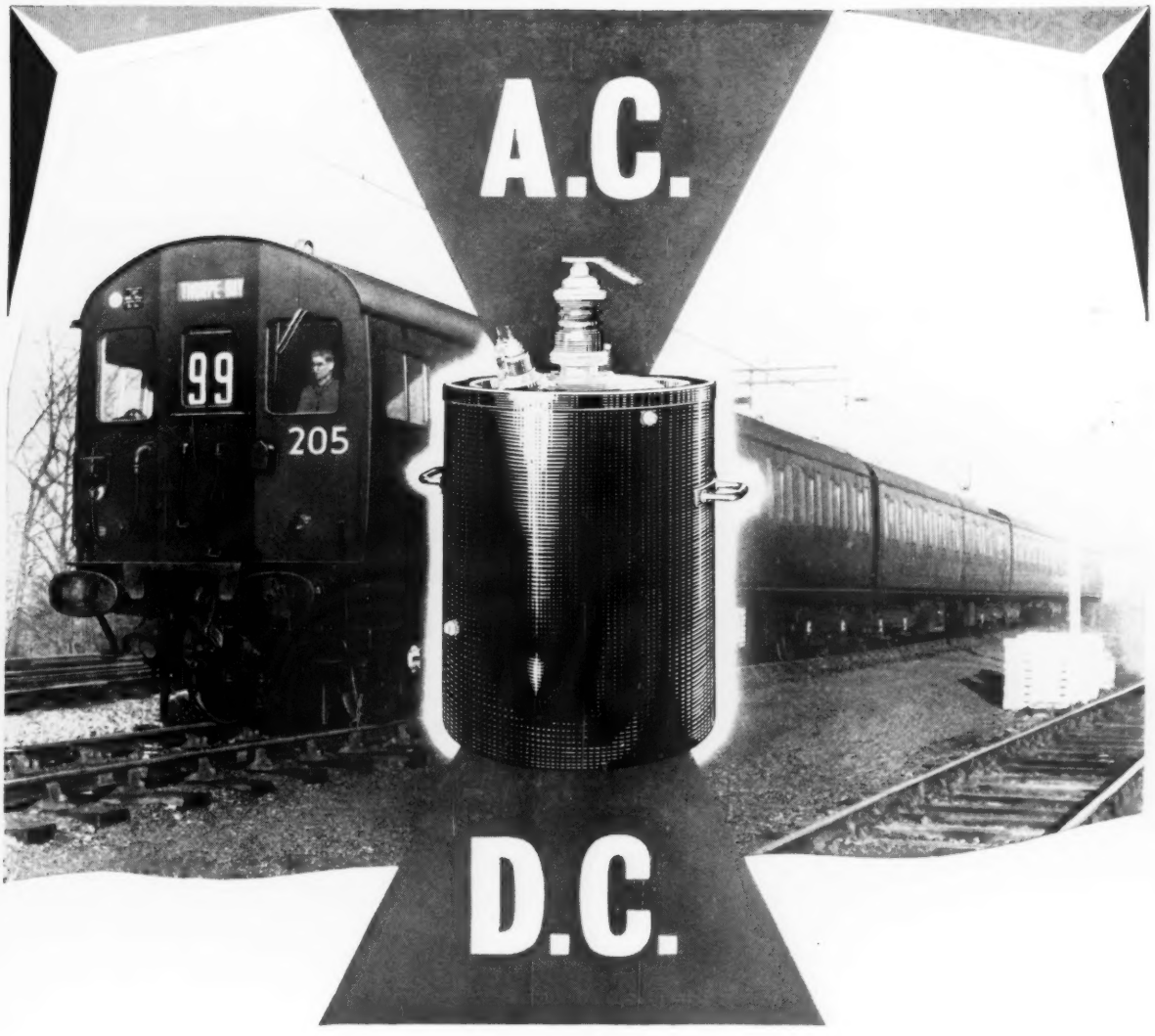

The 'ENGLISH ELECTRIC' equipment on the first A.C. motor coach set for the British Transport Commission Modernisation Scheme incorporates four single anode steel tank mercury arc rectifiers. This set was commissioned in December 1958 on the Styal training section near Manchester. Other coach sets have operated since February 1959 on the Colchester-Clacton line.

Each of the 112 four-car sets to be operated on the Tilbury-Southend line will carry rectifier equipment by 'ENGLISH ELECTRIC'.

Silicon rectifier equipments are also available.

'ENGLISH ELECTRIC' rectifiers

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Rectifier Substation Department, Stafford

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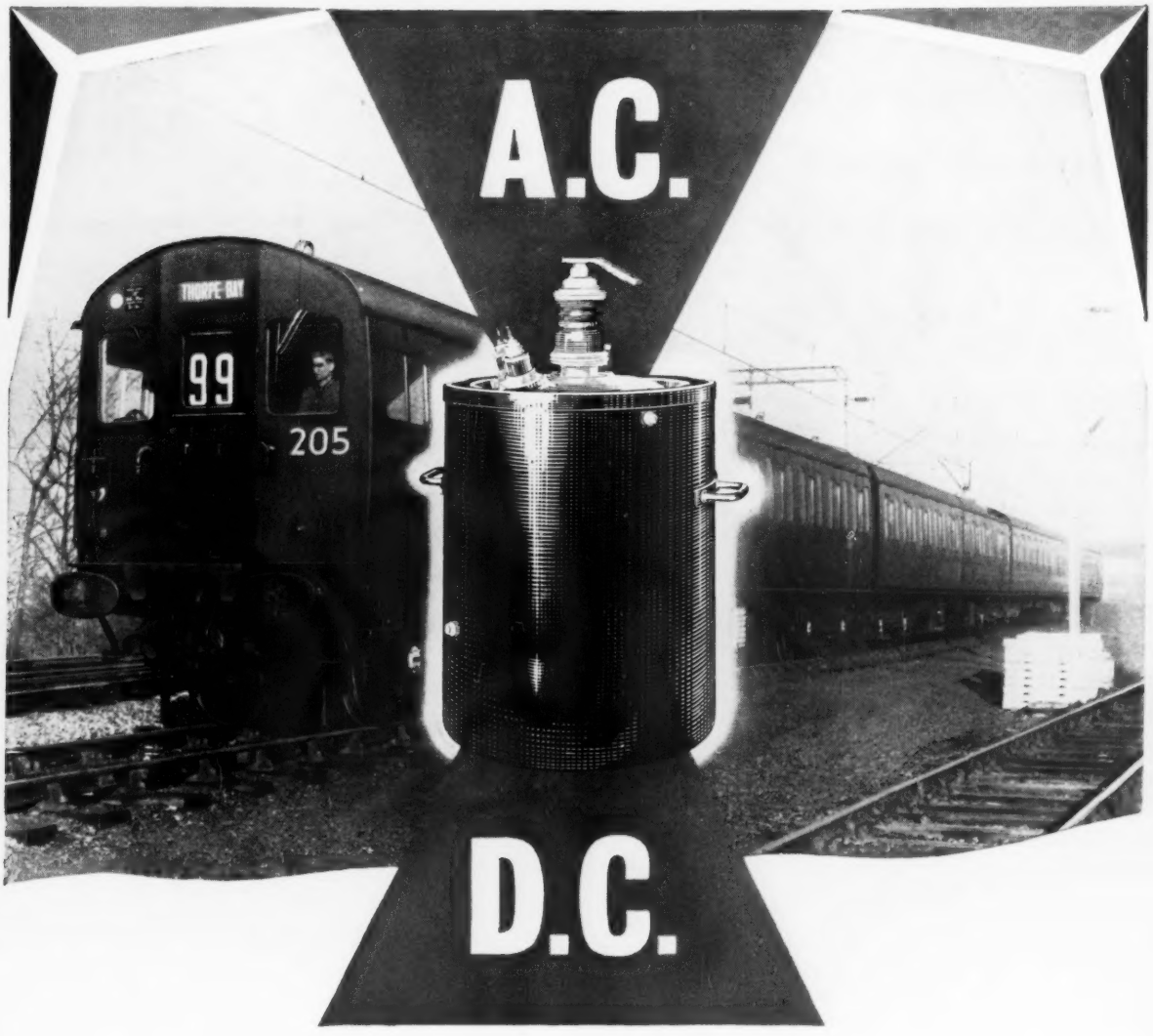

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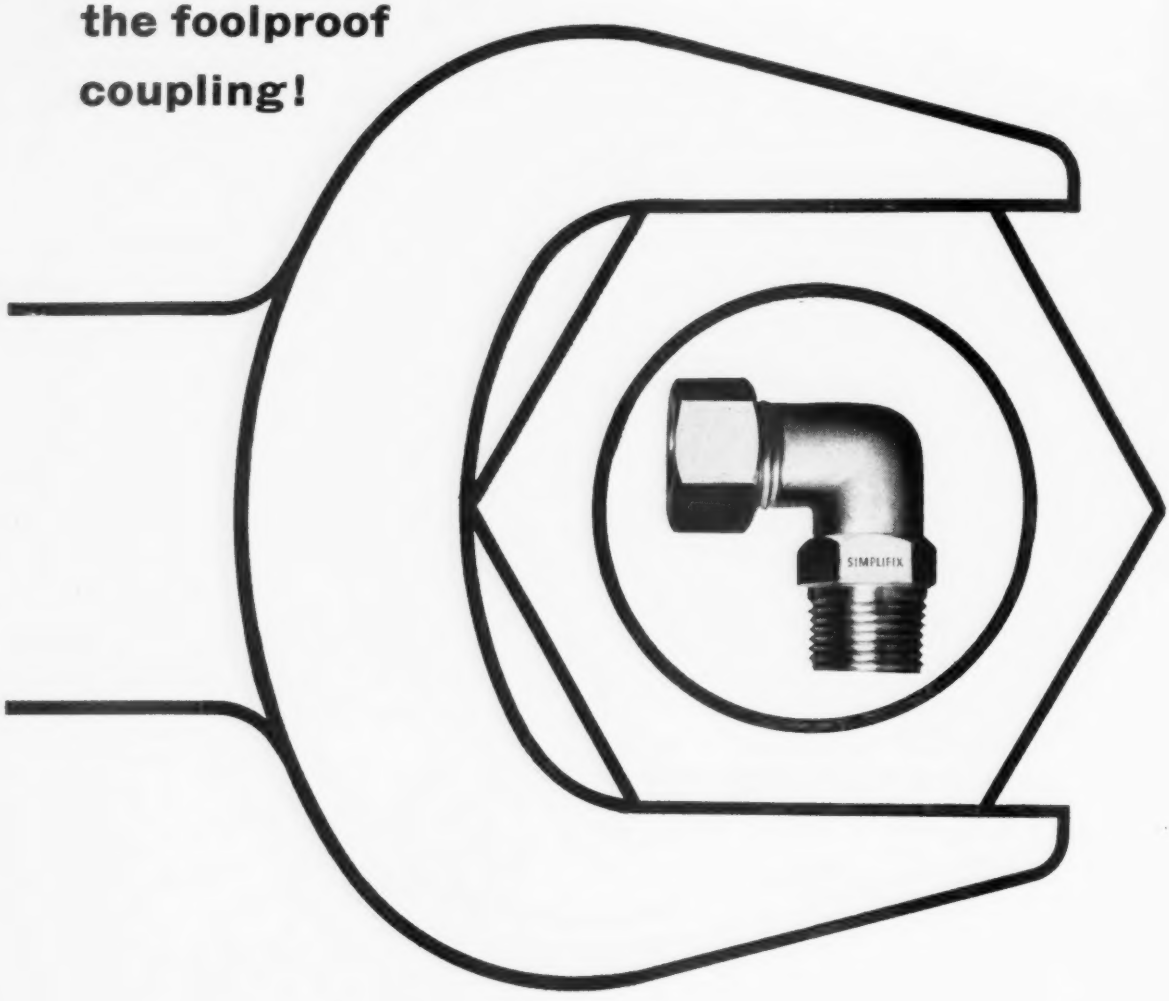

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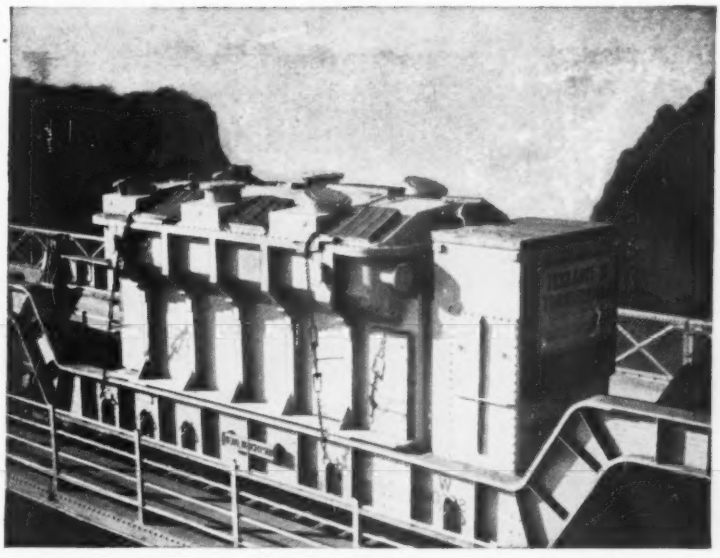

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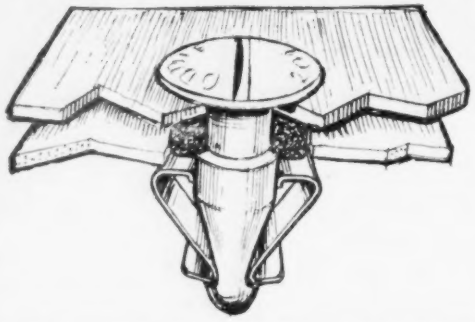

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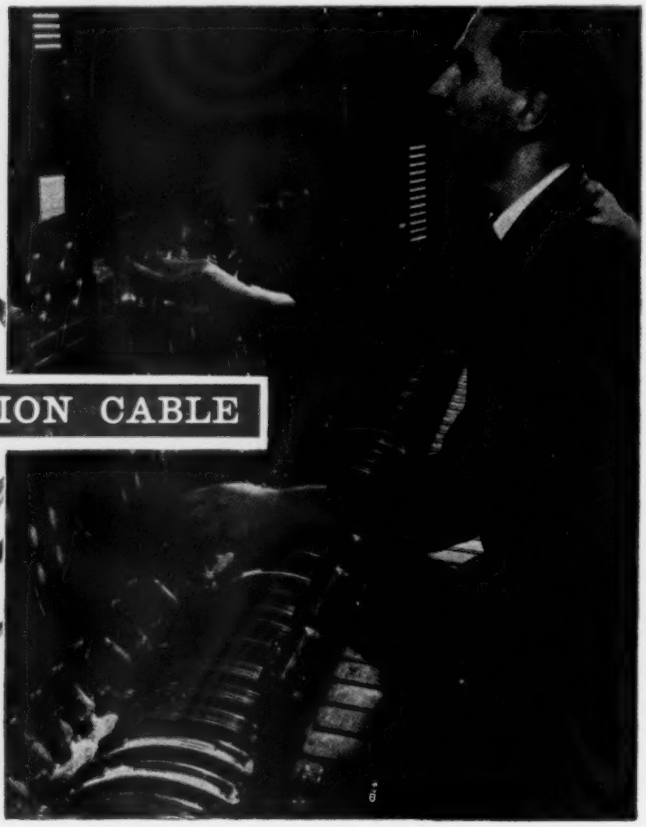

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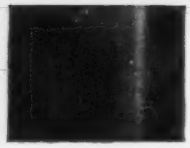

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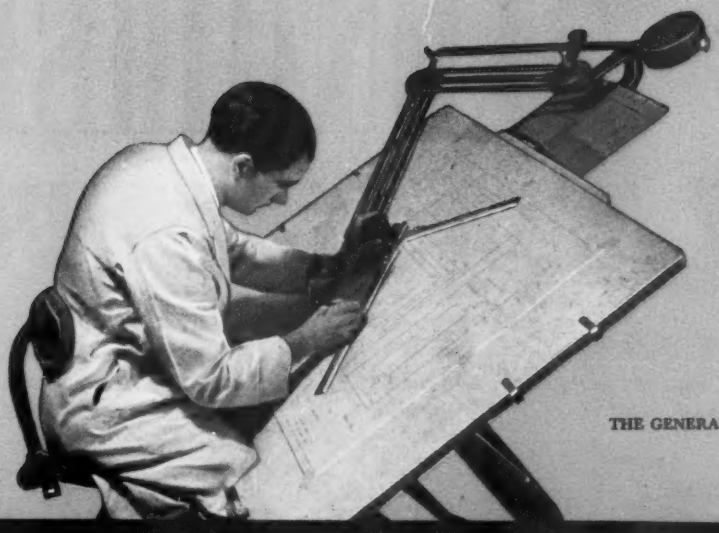

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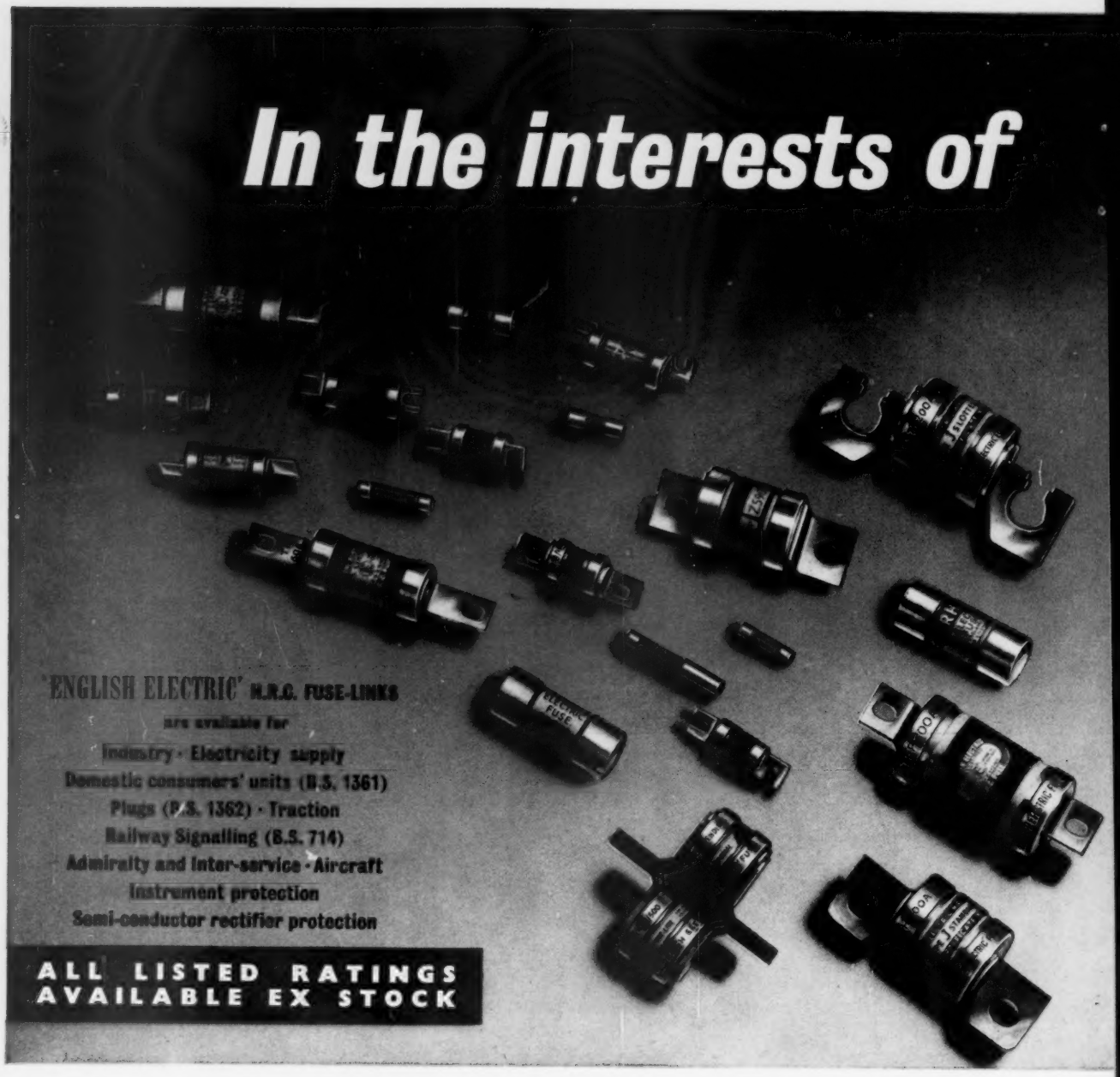

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long traverse vertical

★ now make high winding speeds possible with the finer gauge wires

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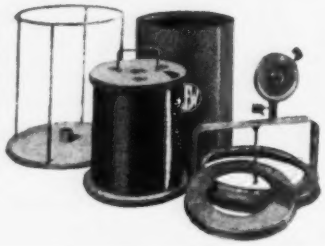
The unit has been specially designed for trouble-free operation, but, should a breakage occur, the running end of the wire can be located in a matter of seconds.



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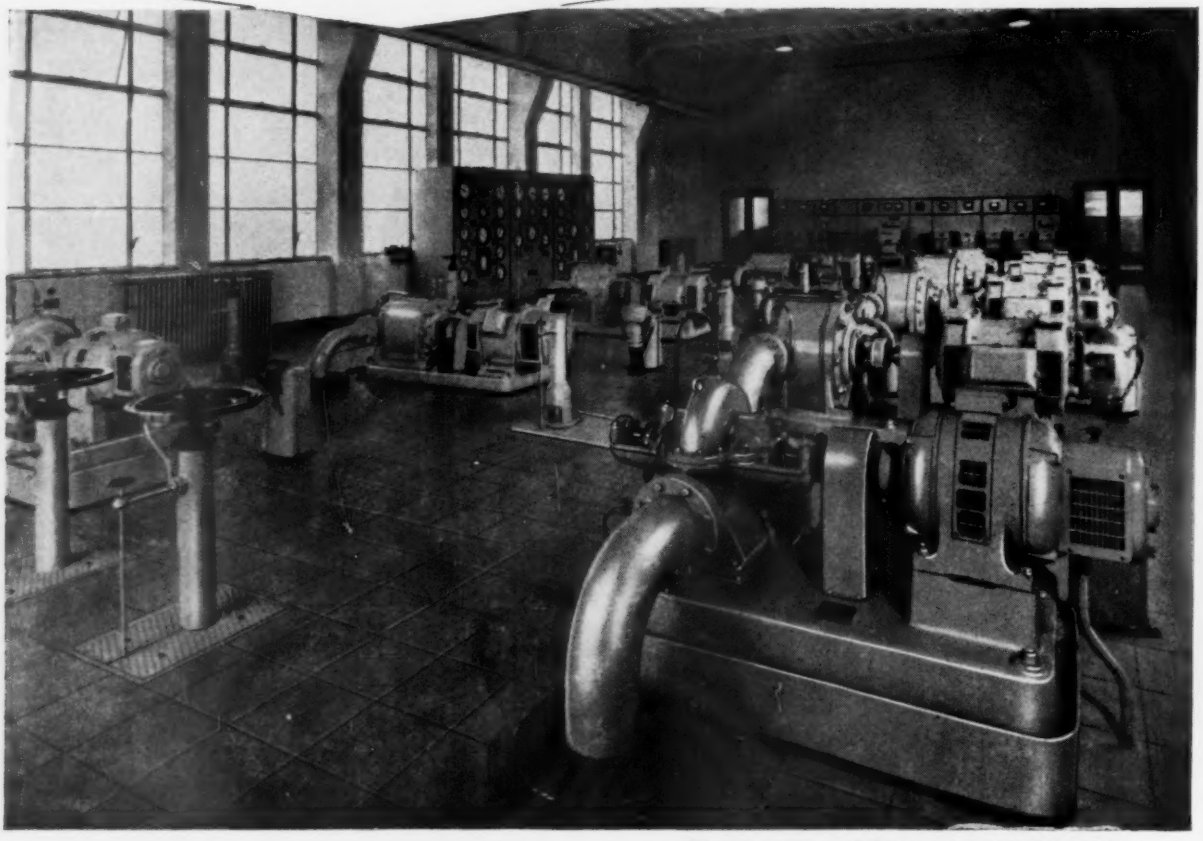

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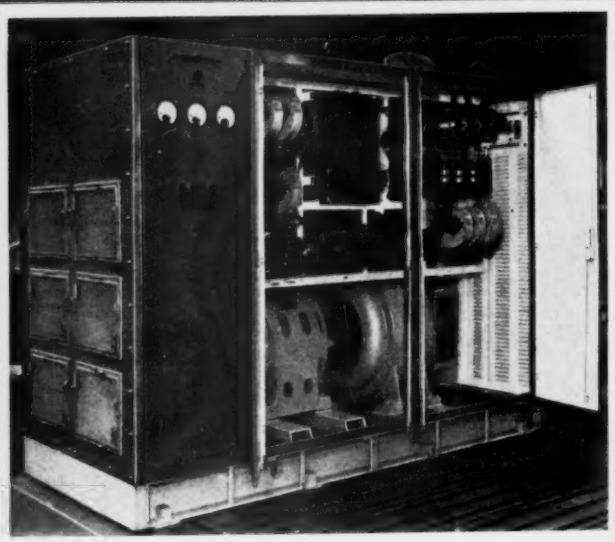
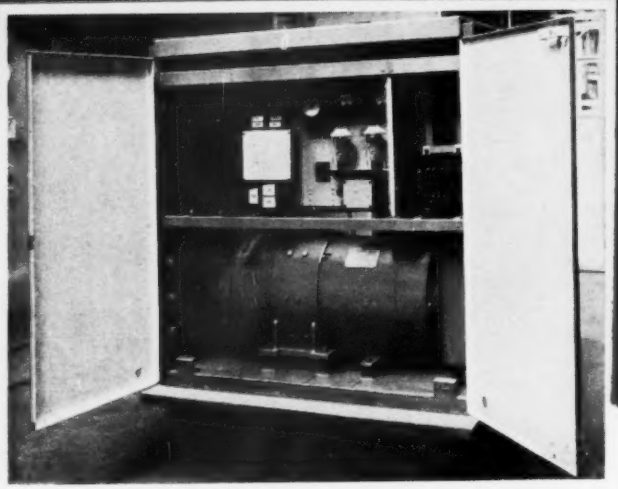


The packaged 100 BHP Ward Leonard set to supply the main calender motor.
Dimensions 118" W. × 86" H. × 51" D.



The packaged 10 BHP Ward Leonard set and electronic gear for synchronising the 5 BHP cooling drums and 5 BHP wind-up drives with the main calender.
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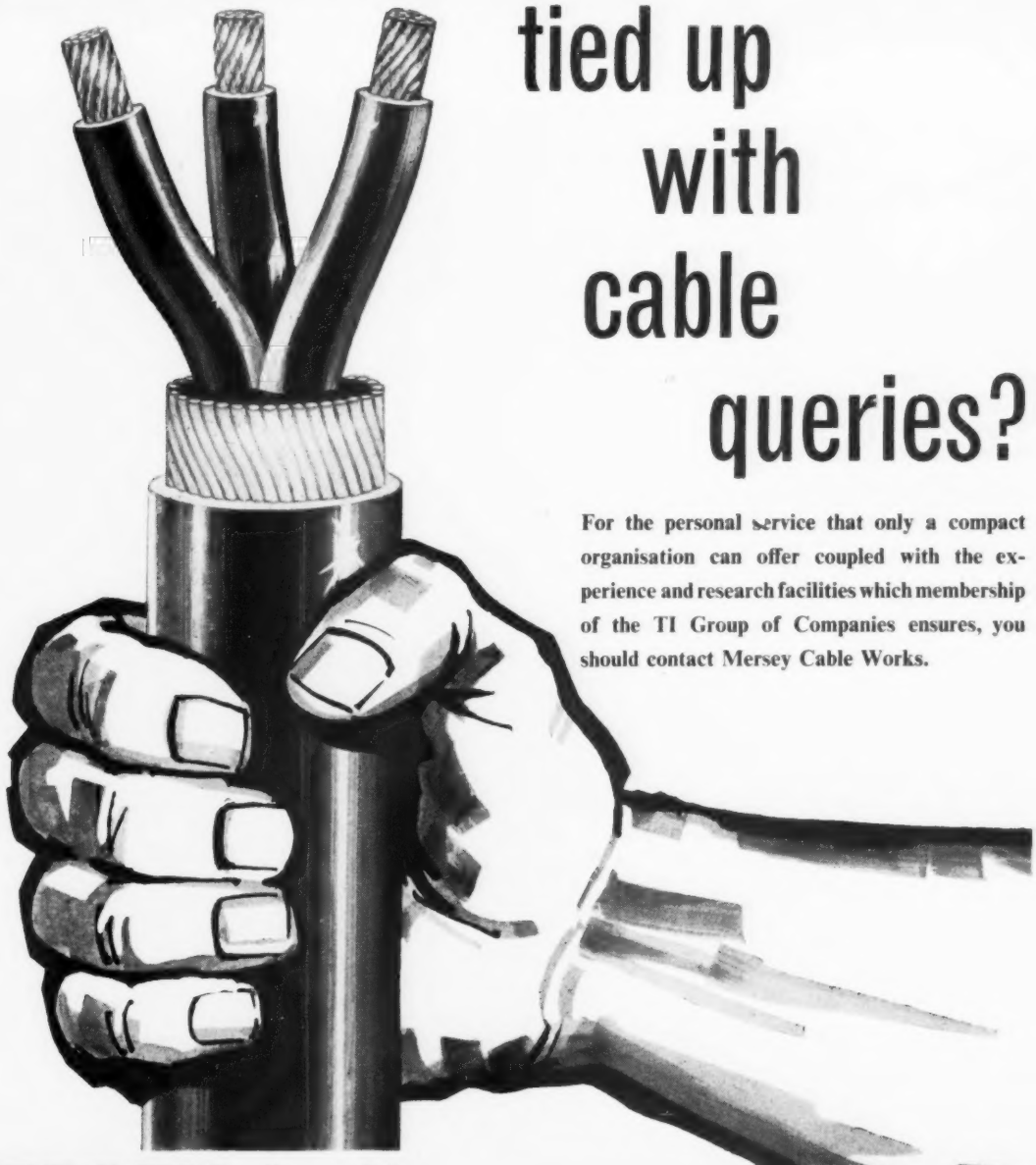

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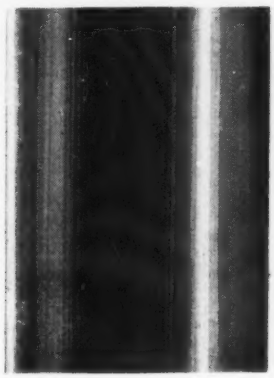

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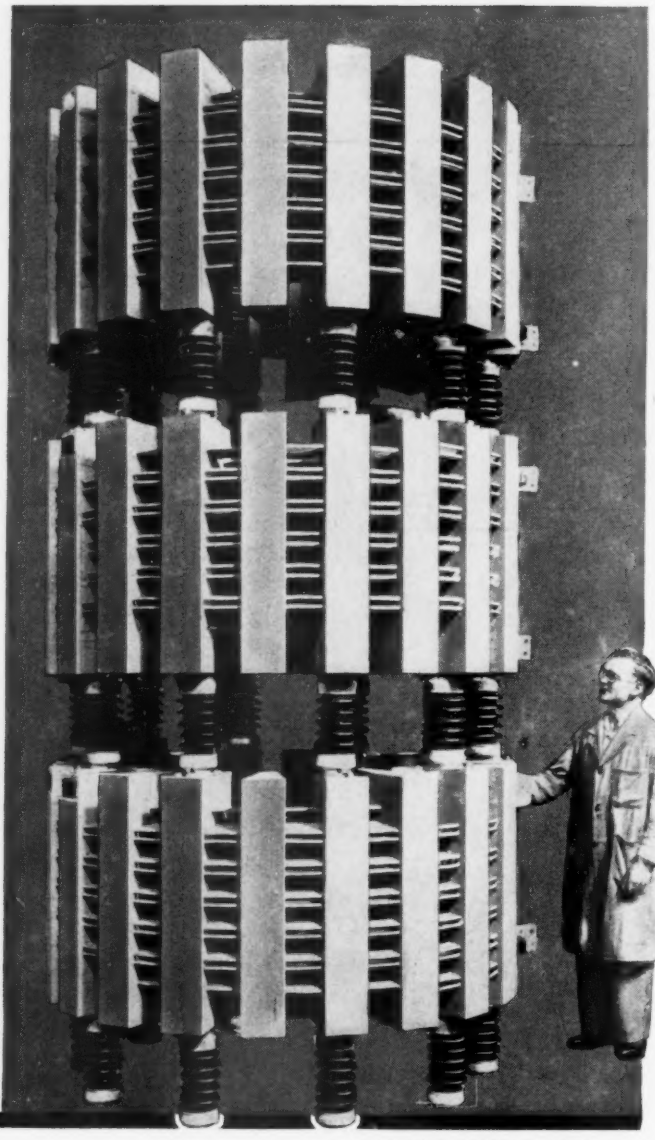

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ELECTRICAL TIMES

SARDINIA HOUSE, SARDINIA STREET, LONDON, W.C.2
Telegrams: Equivolt . Estrand Telephone: HOLborn 6016

Dans ce numéro

Contraintes par impulsion dans les transformateurs — 2e. partie 81

Dans l'étude des contraintes par impulsion dans les transformateurs, on a appliqué, dans un certain nombre de cas importants, un circuit équivalent ayant une gamme d'applications très étendue. Grâce à une analyse au moyen d'un compteur digital, on a obtenu une concordance très satisfaisante entre des valeurs de tension calculées et celles ayant été mesurées.

Inverseurs à transistors pour lampes à décharge ... 87

Les lampes à décharge peuvent maintenant être operées à l'aide d'inverseurs de survoltage incorporant des transistors utilisant une source de c.c. à basse tension. Le rendement est relatif au type de charge, et pour les lampes fluorescentes, les courants à onde sinusoïdale sont préférables aux ceux à onde rectangulaires à des fréquences jusqu'à 25 k Hz. Des développements incorporant des transistors due type p-n-p-n fonctionnant comme intérrupteurs font présager des inverseurs qui seront indépendents du type de charge.

Isolement des câbles pour courants continus h.t. ... 90

Le papier impregné et la polystyrene sont des diélectriques convenants pour l'isolement des câbles. Le polystyrene est vulnérable aux dommages causés par des décharges dans des cavités remplis de gaz. La fréquence de répétition de telles décharges est un facteur important dans le durée des câbles. Toutefois, des expériences et des calculs suggèrent que les dommages aux câbles pour courants continus h.t. ne seront pas sérieux si les tensions d'ondulation sont maintenu basses et si des renversements fréquents de polarité sont évités.

Fours à Arc 99

Les fours à arc pour la plus grande installation du monde pour la production d'acier auront chacun une puissance de 40 MVA. Les caracteristiques comprennent des transformateurs régulateurs à changement de prise sous charge, qui alimentent le transformateur principal trifasé d'un source de 33 KV.

In dieser Nummer

Stromstossbe'astungen bei Transformatorwicklungen, 2. Teil 81

Eine zur Untersuchung der in Transformatorwicklungen auftretenden Stromstossbelastungen viefach anwendbare Vergleichsschaltung ist nunmehr bein einer Reihe aufschlussreicher Fälle erprobt worden. Nach der Auswertung mittels Digitalrenchenanlage hat sich eine weitgehende Uebereinstimmung zwischen berechneter und gemessener Spannung ergeben.

Transistorisierte Wechselrichter für Gasentladungsröhren 87

Gasentladungsröhren können jetzt durch Verwendung von transistorisierten Aufwärts-Wechselrichtern aus Niederspannungs-Gleichstromquellen gespeist werden. Die Leistung hängt von der Belastungsart ab, und im Falle von Leuchtröhren ist bei Frequenzen bis zu 25 kHz die sinusartige der rechteckigen Wellenform vorzuziehen. Entwicklungen auf der Grundlage von p-n-p-n Schaltern lassen auf zukünftige Wechselrichter hoffen, die von der Belastungsart unabhängig sind.

Isolierung von Hochspannungs-Gleichstromkabeln ... 90

Geeignete Dielektrika für Hochspannungs-Gleichstromkabel sind imprägniertes Papier und Polythene. Polythene ist nicht widerstandsfähig gegen Beschädigung durch Entladungen in gasgefüllten Hohlräumen, und die Häufigkeit solcher Entladungen im Gleichstrombetrieb ist ein bestimmender Faktor für die Lebensdauer von Kabeln. Berechnungen und Messungen weisen jedoch darauf hin, dass ausgeprägte Welligkeit und häufiges Umpolen vermieden wird.

Lichtbogen-Elektro-Ofen 99

Lichtbogen-Elektro-Ofen für das grösste Stahlwerk der Welt werden eine Nennleistung von je 40 MVA haben. Erwähnenswert unter den Hauptmerkmalen ist der Abgriff-Wechsel bei Voll-Last in einem Regeltransformator zur Speisung des Drehstrom-Haupttransformators aus einem 33 kV-Netz.

Impulse Stresses in Transformer Windings—Part 2 ... 81
by R. A. Zambardino, DR.ING., A.M.I.E.E.

Diesels and Gas-turbines 84

Testing 200 MVA Transformers 85

The E.A.W. Story 86

Transistorised Inverters 87

Life of H.V. D.C. Cables 90

Oil Switches for Metalclad Boards 92

International Standards Advance 92

INDUSTRIAL ELECTRICITY

More Power in Works' Electrical Generation ... 93

Electronic Aids to Motor Testing 94

Limit Switch Safety 95

Do Defects in Welds Matter? 96

Packaged Substation Saves Space 96

Data Sheet No. 36—Control Gear Glossary 97

Arc Furnaces for Largest Electric Steel Plant 99

Progress in Manufacture, 1959—Bruce Peebles ... 105

Rapid Detection of Fire 108

Transformers for Bridges 108

FEATURES

Progress in Patents 89
Overseas News 100
Personalities in the Industry 102
British Standards 103
New Literature 104
Equipment for Industry 106
For the Electrical Trade 107
Problems and Practice 109
News of the Week 110
Company Activities 116
Commercial Information 117

News Sheet 25
Classified Advertisements 49
Index to Advertisers 56

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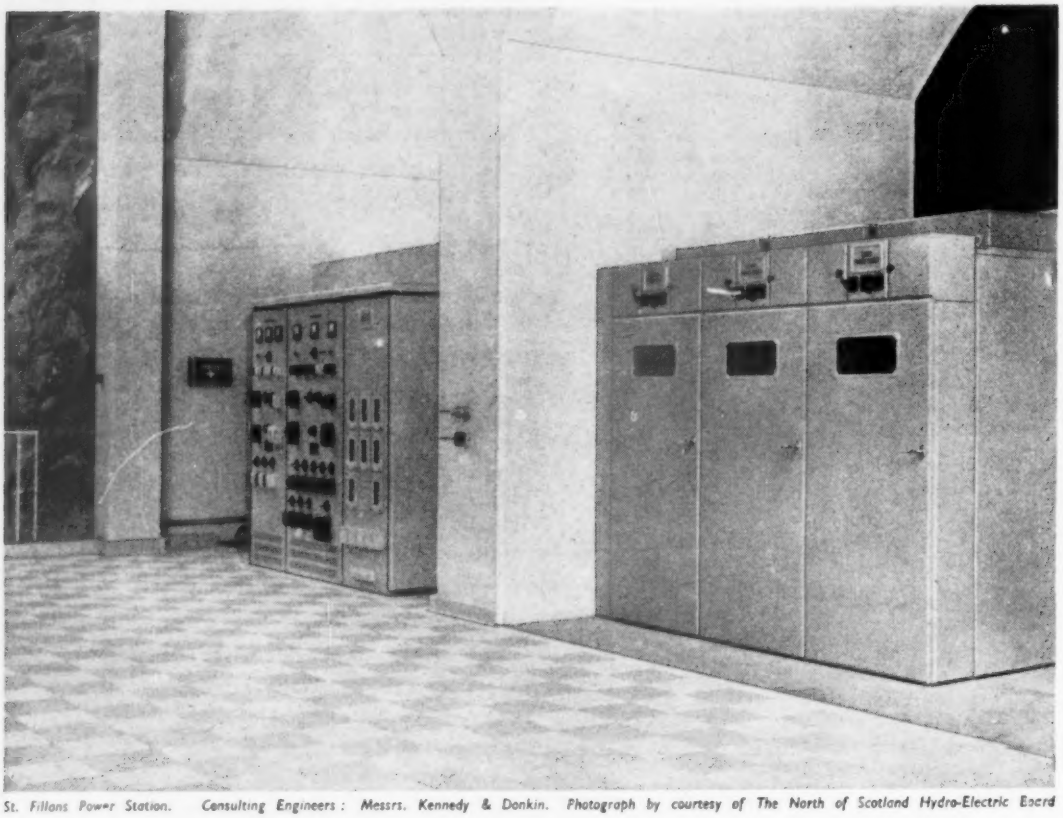

St. Fillans Power Station. Consulting Engineers: Messrs. Kennedy & Donkin. Photograph by courtesy of The North of Scotland Hydro-Electric Board

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ESTABLISHED 1891

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Comment

HOW LONG A COAL SURPLUS?

During 1959, electricity made its conventional 7% advance on the total generation of the previous year; but in doing so, it burned only the same amount of coal as in 1958. That statistic is one of many bleak facts recorded in an NCB review of 1959. The advance in oil firing made a major impact on the year, for about 70% more oil was burned in power stations than in 1958, the four million tons involved being equivalent to about 6¾ million tons of coal. From the current year onwards, however, the additional oil-burning programme each year will be relatively small (though oil will be economic for some new stations), and the effect of nuclear generation will come relatively slowly in comparison with a plant programme of about 2,000 MW per year. Against this background, it is pertinent to note that the gap between saleable output of coal by the NCB and inland consumption was about 16 million tons last year. If all that were suitable for power station firing (most is), and if the whole future expansion of electricity were taken from coal, then the surplus would meet electricity requirements for less than five years at the present rate of expansion. That is an over-simplification, neglecting the cut back in coal production last year, effects of electricity growth in reducing direct burning of coal, and ignoring, as well, improvements in thermal efficiency of generation; but it does show how short-sighted are the attacks of those who argue that electricity supply should switch from any interest in forms of generation other than coal based. In particular, it answers those who want extremely large cuts in the nuclear programme. The coal industry has had a breathing space from insistent electricity supply demand which has come at an inconvenient time. It cannot for long hope to meet all electricity's requirements.

E.A.W. IMPORTANCE

So effectively has the Electrical Association for Women established for itself a place in the electrical industry's activities, that there is seldom an occasion to consider its organisation and purpose against the changing background of the industry. The present is a good time for this exercise, for the fast expansion both of the range of domestic appliances available and of the number in use is enhancing the importance of having relatively well-informed users amongst the industry's customers. How the Association sees its own purpose in this environment was succinctly stated by Miss Mary George, the present director, in a lecture delivered this week to the ASEE. An important aim is creation of a body of informed opinion through formal education and "general interest" talks on things

electrical, involving both EAW members and also groups with a potential interest, such as school domestic science classes. It would be difficult to over-estimate the significance of such work to the electrical industry. The housewife hears a lot about the claims of different appliances and different fuels, so much that she may well find difficulty in separating grain from chaff. When her interest quite suddenly becomes real and immediate (as it does when she switches from general interest to the state of intending purchaser), friends who have looked into the essential questions at issue are likely to be appealed to. EAW members and trainees come into their own in just these circumstances, and apart from the general value of their knowledge in making a satisfactory purchase more likely, they can ensure that the qualities of electrical methods are not overlooked. Although this is far from being the only function of the Association—the feedback of women's viewpoints to manufacturers is of first-rate importance—it is the one of supreme significance in the present competitive conditions.

TRANSISTORS IN LIGHTING

Lighting installations in public transport vehicles, powered by transistorised inverters, are a striking example of the way these devices are finding widening application in electrical power applications, following hard on the heels of the simpler semiconductor rectifiers. Transistors can provide the essential elements in the generation of multi-kilocycle supplies at voltages convenient for fluorescent tubes, when relatively low-voltage d.c. sources are all that can be made available. Indeed, such are the qualities of the transistorised power packs proposed, that their internal efficiency combined with better tube luminous efficiency at high frequency compared with 50 c/s may equal or better that with direct supply from a.c. power mains. The authors of an IEE paper presented last week envisaged far wider applications than the aircraft and rail carriages so far involved in this country; and they looked as well to some of the coming forms of transistor to make this practicable. In particular, the bringing into full quantity production of the *p-n-p-n* variation, with characteristics equivalent to the thyratron, should bring advances in power transistor technology that are not confined to inverters for lighting.

POLYTHENE PROSPECTS

Polythene has outstanding qualities as a dielectric for h.v. cables, yet a relatively early limit has been set to the voltage for which it is in use. This is largely because it has not proved possible to apply the polythene to conductors in a completely homogeneous manner. Voids always appear, and these become the seat of discharges under high voltage stresses; and polythene is extremely vulnerable to discharge damage. How far this consideration is likely to affect application of polythene to h.v. direct current cables was discussed at an IEE meeting last week. With d.c., the frequency of discharge is less than with 50 c/s a.c., but how much less was not known. It turns out that in this application, discharge damage is unlikely to be an important factor in limiting cable life. So we may yet see polythene used for a major underwater d.c. link, even though the first cross-Channel cable will be manufactured from more familiar impregnated paper. It would have been promising if this conclusion in the paper had been backed up by some hint, in either paper or discussion, that an early solution was in sight for the problem of applying polythene to a conductor in a completely void-free manner; but there was no suggestion of this. Indeed, it does not seem clear whether the correct road to this desirable end in the evolution of cable dielectrics lies in perseverance with polythene, or in encouragement to the chemists to produce some entirely new material, engineered to the particular needs of the cable makers. As one contributor to the discussion suggested, the present line of chemical approach to many problems suggests that concentrated work on such a project might be fruitful.

LIMITS FOR THE UNEXPECTED

Limit switches are an important element in most automatic control schemes, whether they be long-established like the levelling device on a lift, or part of some new arrangement for close regulation and fast working on a production line. There is comparatively little difficulty in finding a switch that can carry out the function required under normal operating conditions, or in designing a circuit which will integrate the switch economically with the main drives. Where ingenuity in design is most needed is to incorporate double-check features that will at least guard against incorrect operation when something unusual has happened. This becomes important when the switch has associated with it some safety function, such as making a circuit dead or locking a mechanical guard in position, but the same considerations apply from the aspect of avoiding expensive damage to plant. Some recent suggestions to this end are summarised in this week's *Industrial Electricity* section. From them, two checks stand out as pre-eminently desirable. First, on the mechanical details of operating limit switches, there should not be complete reliance on a spring, for springs may fatigue and break. Although a spring may be used to give quick action, it should always be backed-up by a solid mechanical link between operating element and switch contact, so arranged that if the spring fails, safety features are assured. The other detail that requires close scrutiny is the likely action of an earth fault on any part of the control wiring; and of multiple earth faults. These can short out safety contacts or operating coils, and quite cancel out fail-safe features; yet it is usually possible to arrange the order of components in series circuits to avoid this possibility.

Meteor

This week's quick summary of electrical news faces advertisement page 24.

Impulse stresses in transformer windings

Part 2—by R. A. Zambardino,* DR. ING., A.M.I.E.E.

IN the first part of this article, the problem of impulse stresses in transformers was surveyed. It was shown that for interleaved windings, the maximum stresses occurring for most practical conditions is given by the initial voltage distribution. Suitable programmes for a DEUCE electronic digital computer to carry out the necessary calculations were described, and the good agreement between calculated values and those measured during impulse tests demonstrated. In the present concluding part of the article, further examples of calculations are given, and the advantages discussed.

Electromagnetic Voltage

The voltage produced at transformer terminals, floating or connected to external circuits, when impulse voltages are applied to another terminal can be calculated with good accuracy by means of appropriate equivalent circuits.

An extremely useful equivalent circuit is the one shown in Fig. 18, and a DEUCE programme has been prepared to calculate the voltage at A for impulse voltage of any specified waveshape applied to H. The input data are the parameters defining the waveshape, the number of voltage values required, the time interval between them and the values of the various lumped impedances, the values 0 and ∞ being permissible for any of them. The results, for a normal calculation requiring the voltage at A at 50 to 100 different instants of time, are obtained in under 1 minute. If required it is possible to take into account the influence of the voltage transferred electrostatically to the terminal under consideration. In the most frequent cases this voltage can be assumed as the initial value of the voltage at A and account of it is taken in solving the differential equations of the circuit. Therefore, when required, the initial voltage at the terminal, calculated by means of the DEUCE programme described earlier can be fed as additional data in the programme calculating the circuit of Fig. 18. The programme can also take into account, when required, the magnetising inductance and the internal resistances of the transformer. However, since their influence is in most cases negligible, these parameters can usually be omitted. Some examples of the most frequent and important applications of this circuit are given below:

(i) *Voltage produced at the neutral end of a transformer or reactor winding when impulse voltages are applied to the opposite terminal.*

The calculation can be carried out by using the circuit of Fig 18. In this case L should be taken as the inductance of the winding and C the total capacitance to earth at the terminal, i.e. the effective shunt capacitance of the winding plus any other external capacitance (cables, busbars, etc). If the terminal is floating L_1 and R will be equal to ∞. If the terminal is connected to external

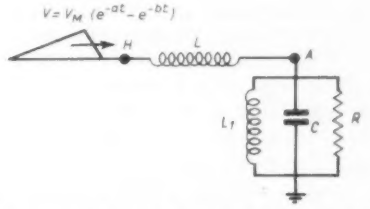


Fig. 18. Basic equivalent circuit for calculating the voltage produced at transformer terminals floating or connected to external circuits, when impulse voltages are applied to other terminals

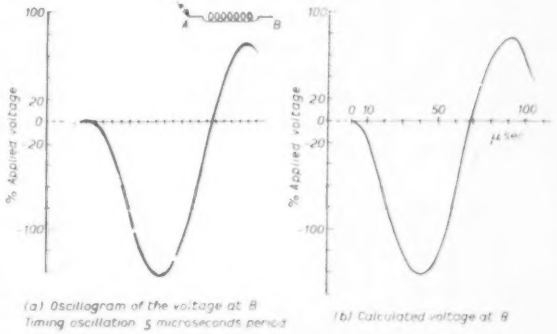


Fig. 19. Measured and calculated voltage at the floating end of a 132 kV 2·1 MVA reactor for 1/50 microsecond impulse applied to the opposite end

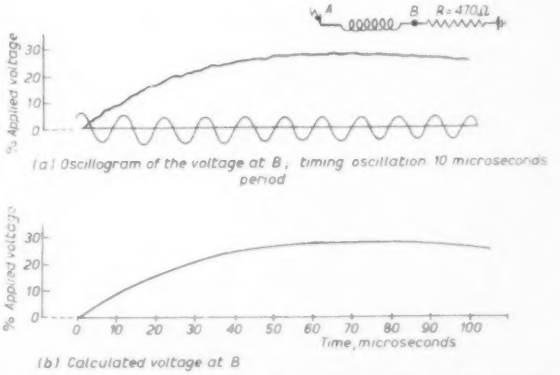


Fig. 20. Measured and calculated voltage at one terminal of a 132 kV 2·1 MVA reactor when connected to a resistance equivalent to the surge impedance or a transmission line, for 1/50 microsecond impulse applied to the opposite terminal

* Dr Zambardino is with the Nelson Engineering Laboratories, English Electric Co. Part I of the article appeared in the issue of 7 January.

loads, e.g. transmission lines, alternators, reactors etc. L_1 and R must be given the appropriate values.

If the terminal is floating and the series capacitance of the winding is not too small compared with the capacitance C, the influence of the initial electrostatic voltage can be appreciable. In this case the initial voltage at A is calculated by means of the programme described earlier and then taken as a new data. Fig. 19 shows the measured and calculated voltages at the floating far end of a 132 kV reactor for 1/50 microseconds impulse applied to the opposite terminal.

Fig. 20 shows the measured and calculated voltages arising at the same terminal when connected to a 470 ohms resistance simulating the surge impedance of a transmission line.

(ii) *Voltage arising at the unearthed terminals of an autotransformer under impulse conditions.*

When an impulse voltage strikes the h.v. or the l.v. terminals of an autotransformer, high voltages can be produced at the l.v. or h.v. terminal respectively, especially in open-circuit conditions.

The circuit of Fig. 18 can be used to calculate these voltages. In this case L is the leakage inductance h.v. to l.v. and C is the effective capacitance to earth at the terminal considered; L_1 and R will be infinite if the terminal is open circuited or will be given the appropriate values if a load is connected.

If the impulse is applied to the l.v. terminal its amplitude for the calculations must be multiplied by $(n_h+n_l)/n_l$, where n_h and n_l are the number of turns of the h.v. and l.v. windings, and the leakage inductance will be referred to the h.v. If the impulse is applied to the h.v. terminal, its amplitude must be multiplied by $n_l/(n_l+n_h)$, and the leakage inductance referred to the l.v.

Fig. 21 shows the calculated and measured voltages at the floating 275 kV terminal of a 275/132 kV autotransformer for 1/50 microseconds impulse applied to the 132 kV terminal.

Account was taken of the initial voltage at the 275 kV terminal, the initial voltage distribution for this autotransformer being shown in Fig. 15 (Pt. 1). It can be noticed that as an effect of the use of interleaved windings a very uniform initial voltage distribution is achieved while the maximum voltage at the h.v. terminal is not higher in percentage than the corresponding turns ratio.

Fig. 22 shows the calculated and measured voltages at the floating 132 kV terminal of the same autotransformer for 1/50 microseconds impulses applied to the 275 kV terminal. Account was taken of the initial electrostatic voltage at the 132 kV terminal.

It can be seen how the maximum voltage is not higher in percentage than the corresponding turns ratio.

(iii) *Voltage transferred to windings other than the one to which impulse is applied.*

The circuit of Fig. 18 can be used to determine the voltage arising at the secondary terminal of star/star transformers, under impulse conditions.

If the transformer has three windings the values of inductances to be used are given by the star equivalent circuit of a three-winding transformer. If the third winding is short-circuited the equivalent circuit of Fig. 18 can be used. If the windings are open circuited or connected to capacitive loads the equivalent circuit shown in Fig. 26 can be used for the calculations.

(iv) *Voltage transferred to a delta l.v. winding when impulse voltage is applied to the h.v. star.*

The equivalent circuit for this case is shown in Fig. 23 and it corresponds to the one in Fig. 18. R, L_1 and C must be given the appropriate values corresponding to the external impedance Z_0.

Fig. 24 shows the calculated and measured voltages at one of the l.v. terminals of a star/delta 330/18 kV transformer for impulse applied to one of the 330 kV terminals and l.v. left floating.

Fig. 25 shows the calculated and measured voltages at one of the l.v. terminals for the same transformer but with the l.v. connected to a circuit simulating the alternator.

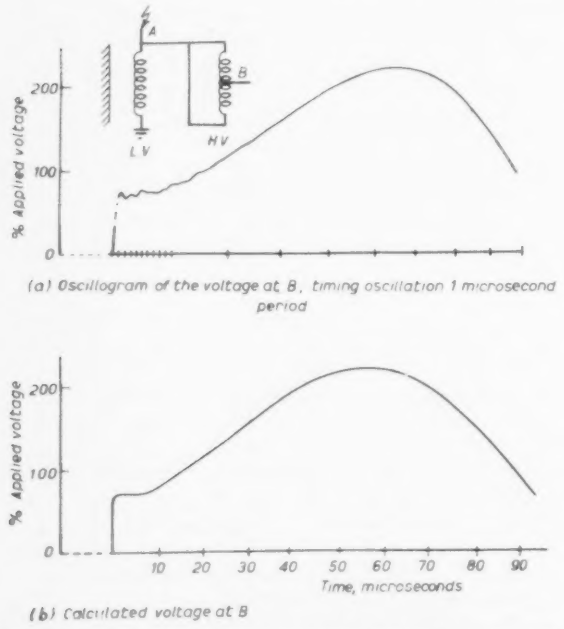


Fig. 21. Measured and calculated voltage at the floating 275 kV terminal of a 275/132 kV autotransformer for 1/50 microsecond impulse applied to the 132 kV terminal

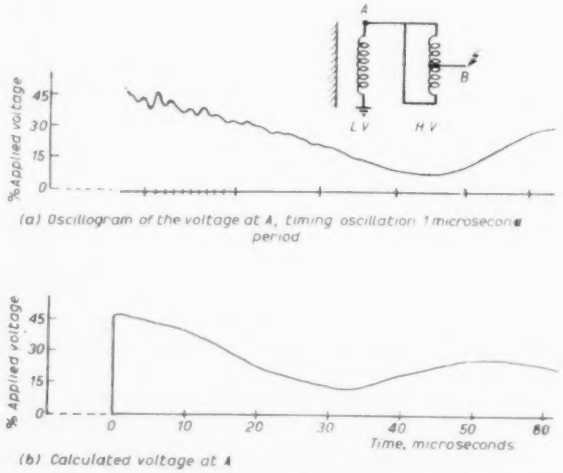


Fig. 22. Measured and calculated voltage at the floating terminal of a 275/132 kV autotransformer for a 1/50 microsecond impulse applied to the 275 kV terminal

The circuit of Fig. 18 can also be applied for calculating a first approximation value of the minimum resistance required for protective non-linear resistors, required to limit the voltage transferred to a transformer terminal to a prefixed value.

Other equivalent circuits for which DEUCE programmes have been prepared are shown in Fig. 26 and 27. The circuit of Fig. 26 can be applied to calculations of the transferred voltage for three-winding transformers. The circuit of Fig. 27 can be applied to calculate the voltage electrostatically transferred to an open-circuited terminal when an impulse of any specified waveshape is applied to the terminal of another winding. This circuit takes into account the subsequent current in the open-circuited winding set up by the electrostatically transferred voltage. Another DEUCE programme has been prepared to cope with more complicated circuits whose differential equations, in Laplace form, contain cubic polynominal factors.

The above examples of application of equivalent circuits to the calculation of impulse stresses show the great advantages they offer. The availability of DEUCE programmes for these calculations allows the designer to investigate with a high degree of accuracy the stresses to which a transformer can be subjected in practically all possible service and test conditions in a matter of minutes and at a negligible cost.

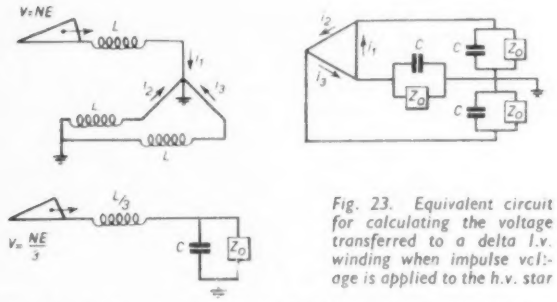
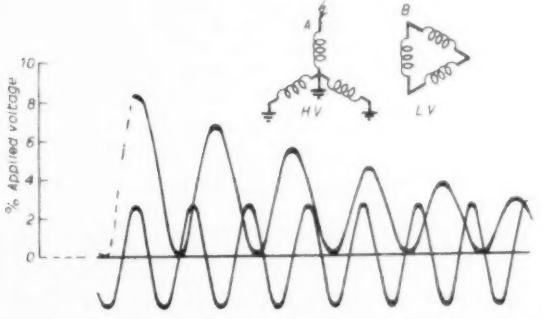
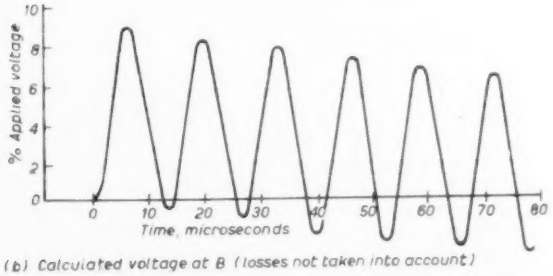


Fig. 23. Equivalent circuit for calculating the voltage transferred to a delta l.v. winding when impulse voltage is applied to the h.v. star

N = turns ratio. E = amplitude of applied voltage. L = leakage inductance per phase, referred to l.v. side. C = effective capacitance at l.v. terminals. Z_0 = external loads connected to l.v. i_1, i_2, i_3 = currents on the l.v. side of the transformer. The same equivalent circuit applies to the case of an impulse voltage striking two h.v. terminals of the transformer



(a) Oscillogram of the voltage at B; timing oscillation 10 microseconds period



(b) Calculated voltage at B (losses not taken into account)

Fig. 24. Measured and calculated voltage at one terminal of the floating l.v. of a 330/18 kV transformer for 1/50 microsecond impulse applied to one of the 330 kV terminals

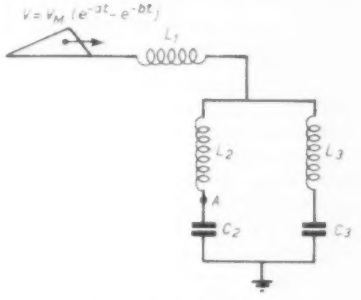


Fig. 26. Basic equivalent circuit for calculating transferred voltages in three-winding transformers

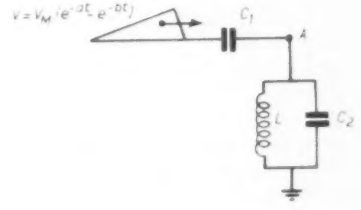
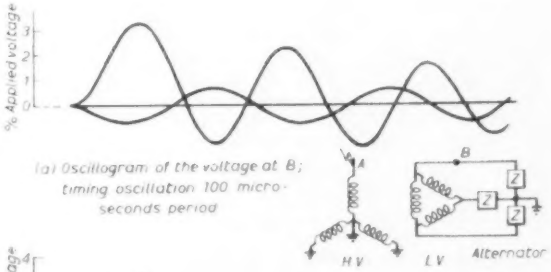
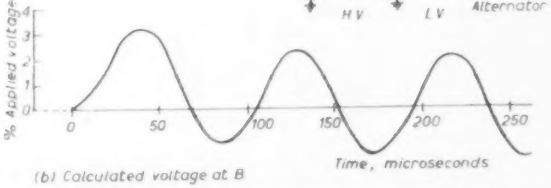


Fig. 27. Basic equivalent circuit for calculating the electrostatic component of the voltage transferred to the floating terminal of a transformer



(a) Oscillogram of the voltage at B; timing oscillation 100 microseconds period



(b) Calculated voltage at B

Fig. 25. Measured and calculated voltage at one 18 kV terminal of a 330/18 kV transformer for 1/50 microsecond impulse applied to one 330 kV terminal with the l.v. connected to a circuit simulating the alternator

Conclusions

The impulse stresses that could arise in a transformer, under service or test conditions, are the determining factor in designing the transformer insulation. The number and length of the calculations involved for covering all the most likely test and service conditions for even a few different trial values of the transformer characteristics are such that a direct hand calculation is always a wasteful and often impossible proposition.

A complete calculation of the distributed parameters circuit of Fig. 6 (Part 1) covering its initial, transient and

final behaviour under the impact of impulse voltages for the most likely service and test conditions, would be rather long and sometimes problematic even with digital computers. A complete computer programme of this kind would take a computing time of many hours, whilst storage limitations imply the lumping of the distributed parameters of Fig. 6 in a relatively small number of units, with consequent loss of accuracy. Such a programme, therefore, is best used for development purposes or at the final design stage for transformers presenting particular problems; its use as a routine tool for the transformer designer would be of necessity rather limited. Furthermore, if the use of computers for the complete design of transformers is envisaged, it would be difficult and rather impracticable to incorporate such a programme in the general design programme.

On the other hand theoretical considerations, confirmed by measurements, show that with the English Electric interleaved windings, as a result of the more uniform initial voltage distribution and the consequent low amplitude of the transient oscillations, all the maximum stresses to which the insulation must be proportioned, can be derived from the initial voltage distribution and the electromagnetic terminal voltages; the latter in their turn can be calculated with very good approximation by means of equivalent circuits with lumped parameters.

While various other DEUCE programmes have been and are being prepared for development and research purposes, all the programmes described in this article are intended for routine design use. Care has therefore been taken to achieve very short computing times and, still more important, extreme simplicity of use and easy reading of data and results. Consequently, while all the calculations are carried out in standard "floating binaries" to achieve high accuracy, both the input data and the output results are in decimals. The input data, for all these programmes, are either geometric dimensions of the windings or parameters known to the designer at the earliest design stage, as for instance percentage reactance, turns ratio, external load, etc.

The total computing time for each programme ranges from 30 seconds to two minutes, the cost is therefore quite small and, just as important, delays due to the availability of computer time can be avoided.

Finally, the experience gained in the use of these programmes has confirmed the great possibilities offered by digital computers as a powerful and highly economical design tool.

The author acknowledges the English Electric Co. Ltd. for giving permission for publication of this article.

(Concluded)

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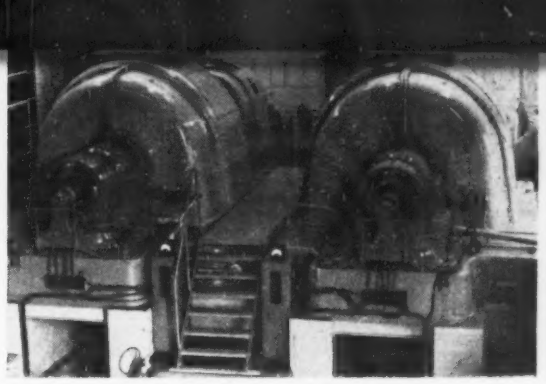
Diesels and Gas-turbines

THE trend of present practice shows that the further development of the diesel engine is inevitably dependent on its association with an exhaust-driven gas-turbine. That is the assumption behind a paper read to the Institution of Mechanical Engineers last week by Mr E. Chatterton, B.SC.(ENG.), M.I.MECH.E., in which three possible methods of association are examined. These are turbocharging, in which the turbine is mechanically coupled to a compressor, this combination mechanically free from the main engine; compounding, in which all three units are coupled together through gears; and the gas generator, in which the whole power of the diesel engine is absorbed in the compressor, and all the power output comes from a separate gas-turbine. The author examines possible performances with these three arrangements, and concludes that the gas generator arrangement at high air manifold pressures and with a two-cycle engine is the most promising, offering maintenance of high torques at low output shaft speeds.

Testing 200 MVA transformers



HACKBRIDGE AND HEWITTIC COMMISSION NEW TEST HOUSE AT WALTON

AN important step in the production of large power transformers is the full-load short-circuit heat run which must be carried out before delivery to ensure that they will meet the specification limits in service. On a large transformer with a rating of 100 MVA or more at high voltages, this necessitates testing equipment of very considerable capacity even though these tests are carried out at low power-factors to achieve the full-load currents in the windings without the dissipation of the full-load power.

Down at Walton-on-Thames, where the Hackbridge and Hewittic Electric Co. are building transformers in ever-increasing sizes, a point had been reached at which the units in production were rapidly exceeding the capacity of the existing testing equipment. To meet this situation, two new testing generators with a step-up transformer and ancillary gear have recently been installed which will now enable them to mount full-scale heat runs on transformers up to 200 MVA at voltages up to 50 kV. In certain cases even this can be exceeded by the addition of capacitors across the alternators. The equipment therefore provides an important addition to the company's testing facilities which must now rank among the most extensive in the country.

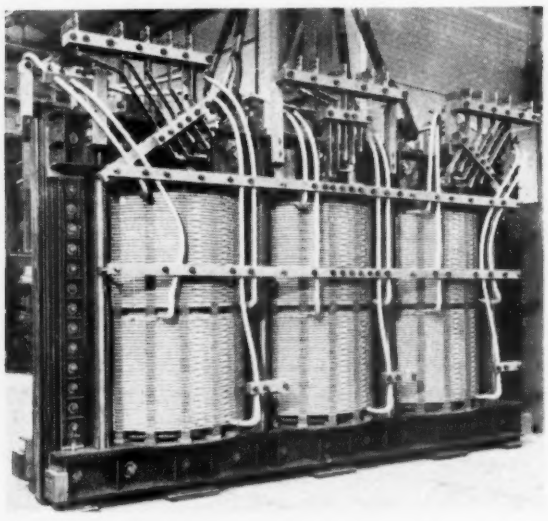
The Motor-alternators

In a separate building located some 150 ft from the test enclosure, two motor-alternator sets are housed, each having a nominal capacity of 15 MVA, the alternators being coupled to and driven by 2,000 h.p. 1,500 r.p.m. synchronous motors with separate direct coupled exciters. Both motor and alternator are of the two-pedestal bearing type with a vernier coupling between the two machines to permit physical adjustment of the phasing. Each motor is auto-transformer started, deriving its power from the local 11 kV supply to the factory, and, like the alternator, is self-cooled by rotor-fans.

The sets are started up from control cubicles in the generator house, each cubicle containing a motor-field regulator, field shorting switch and discharge resistance, ammeter and voltmeter for line and excitation and a synchroscope. Once the machines are running, the output is remote controlled from pushbutton stations on the control gallery of the test area. When the two are running in parallel, currents are equalised by adjustment of the field regulators from the gallery. Regulation of the load at any power factor from 0·1 to 0·01 is provided enabling current equivalent to full loads up to 200 MVA to be supplied to transformers on test.

The large mass of the rotors imposes a high starting torque which is minimised by the provision of pressure oil "jacking" and circulation in the bearings. The oil pressure is supplied by motor driven pumps drawing oil from a 750 gallon sump with thermostatically controlled heaters and water-cooled heat exchangers to ensure a constant temperature regardless of ambient or running conditions. The d.c. motors driving the pumps derive their supply from a rectifier with a battery floating across to ensure that they still run in the event of a mains failure. This is essential since the rotors will continue to run for as long as 40 minutes after a shut-down and failure of oil pressure would result in overheating and damage to the bearings.

The supply to the rectifier is derived from a 11 kV/400 V transformer which also feeds the ventilating fans, circulating pumps, etc. Generator house lighting, oil heater supply and similar services are fed from the factory medium voltage system. Interlocks ensure that the motor-alternators cannot be started until both oil circulating and jacking pumps are running.



The Transformer

The output from the alternators is fed to the transformer house through single core p.i.l.c. cables and isolating switches to two separate primary windings of an oil-insulated, water-cooled transformer with an output to match the machines.

There are three 3-phase secondary windings to the transformer, two of which can be arranged in series or parallel and are rated at 20 kV, 450 amps per phase, the third being rated at 10 kV with four tappings at 2·5 kV steps and a capacity of 900 amps. By using the tapped section to buck or boost the series-parallel sections any voltage from 2·5 to 50 V in 2·5 kV steps can be applied to the terminals of the transformer on test. Regardless of the arrangement, the output side of the

Above: A general view of the two new testing generators at Walton

Left: The core and windings of the water cooled testing transformer. It will be used with both or either of the generators shown at the head of the page

transformer is invariably star-connected with the neutral earthed through primary windings of metering current transformers.

Busbar Connections

The busbars to the test area are copper tubes mounted on pin-type insulators. The isolating switch is under the control of the testing staff on the control gallery. The usual overload and fault protection of the motors is provided together with such alarms and emergency trips as oil temperature, transformer water and oil flow, etc. Buchholz protection is also installed on the transformer and the temperatures of both the windings and the oil are indicated on the gallery.

The motor alternator house is equipped with a 30-ton overhead crane, powerful extraction fans to ensure adequate ventilation and fluorescent lighting. Supply and output cables, the former being paper insulated, lead covered and steel wire armoured, are run in special trenches and ducts in the foundations to give full access at all times.

THE E.A.W. STORY

IT is just over 35 years since the Electrical Association for Women was formed, and the time has been spent busily. So the present director, Miss Mary George, M.B.E., had a full story to tell when she addressed a meeting of the ASEE earlier this week on the Association's history, its present activities, and its plans for the future. The history must be taken as granted in this report; but the present and the plans have a major importance in the industry's activities to extend the use of electricity.

Organisation

One of the developments not generally realised is that the Association is keeping pace with the growth of electricity. In ten years it has achieved the conventional doubling: double the number of branches and double the number of members. An independent body, it is run by a national executive committee, which is backed by a delegate conference meeting twice a year in the form of a national advisory council. This council also draws membership from a number of professional and non-professional bodies with associated interests. Branches are financially independent; each is required to make a small subscription to headquarters. In addition, headquarters receives grants in recognition of educational work carried out.

One of the principal functions of the present EAW headquarters is a public display room. The appliances on loan from manufacturers are not merely exhibited; they are subjected to the sort of use they are likely to be put to by housewives in homes. Comments from the angle of safety or performance are passed to manufacturers, who are found to meet points of criticism on subsequent models.

Through the display room the Association offers the public free advice, which can be particularly useful in narrowing down the sometimes bewildering range of choice, to whatever is the type of appliance best suited to particular home circumstances; but no attempt is made to sell any one model. Also, simple classes on electrical matters are run for the public, with the accent on what it is not safe to do. The limit set is mending fuses and changing plugs.

Foundation of the electrical educational activities of the Association is its homeworkers' course. This is taken in schools and technical colleges, by branches, by home helps sponsored by local authorities, by hospital domestic workers in training and by Red Cross workers. It is aimed to give basic instruction in the handling and care of electricity in the home.

Although headquarters carry out such work, Miss George is explicit that the 200 branches are the spearhead of the Association's national campaigns. She emphasises the importance of a body of informed women, in its effect on public opinion. The Association exercises influence the other way round in channelling to manufacturers opinions on design and performance of equipment. She finds ample evidence that manufacturers welcome constructive comments and suggestions.

Opinion Survey

Next big task for the EAW, as already announced, is to be a survey among its members and members of certain other women's organisations, to find out the extent to which they use electrical appliances, and what they think of the appliances they have. This will also give those questioned the opportunity of making suggestions for improvements or putting forward ideas for new uses of electricity in the home. The survey is to be entitled "Electrical Viewpoint," and will take the form of a questionnaire which is to be distributed within the next few weeks.

Points Miss George thinks likely to influence demand for appliances include simplicity of handling, operating and keeping clean; availability of kitchens properly planned and sufficiently spacious; adequate wiring of houses with sufficient socket-outlets to take new equipment; and the provision of education sufficient to keep up with new domestic techniques and developments.

Turning to the future, Miss George sees the continuing task of EAW to be the exercise of a watching brief for women's interests, taking action as necessary. The original aims of the Association remain valid, and she summarises them as: to interest and educate women in the domestic uses of electricity and to create an informed body of opinion on the subject, to encourage the teaching of electrical housecraft in schools, and to express the woman's point of view on the design and performance of electrical equipment.

Young People

Although these will continue to be the Association's main terms of reference in the foreseeable future, there will be an attempt where possible to direct its work towards young people by increasing contacts with schools, colleges and youth organisations, by promoting interest in the home workers' courses, and by arranging in the branches special programmes and visits to attract younger members. Additionally, through the Caroline Haslett Memorial Trust, there will be training and recruiting of some outstanding young women for careers in electricity.

Transistorised inverters

DESIGN ASPECTS OF DISCHARGE LAMP APPLICATIONS

IN recent years a number of British electrical companies have been concentrating on the development of transistorised inverters for the conversion of low voltage d.c. to a.c. at a different voltage, particularly in reference to fluorescent lighting on aircraft and road or rail coaches. On Thursday last, at the IEE, London, a paper* was read before the Utilisation Section by I. F. Davies, B.SC., A.M.I.E.E., and D. Dunthorne, B.SC., Graduate I.E.E., on the design problems of applying transistors to this specialised task of operating gas-discharge lamps in which the work of the GEC group was revealed in some detail.

Fluorescent Tube Characteristics

An important factor in the design of transistorised power packs is the choice of frequency and waveform, since these affect, and are affected by, the characteristics of the tube itself. As frequency increases, so does the waveform of the lamp voltage change slowly from square to sine waveform with an increase in form factor and luminous efficiency up to around 20 kc/sec at which point the curve appears to end off. There is not much point in raising the frequency above this as the voltage required to start the lamp also increases with frequency. In practice, values somewhat below 20 kc/sec are usually chosen for this reason. Aircraft inverters on the Vickers Vanguard operate at 15 kc/sec, while others designed for the BR operate at as low as 1 kc/sec.

* "The Application of Power Transistors to the Operation of Gas-discharge Lamps from A.C. Supplies." Paper No. 3192.

Square- and Sine-wave Inverters

The first type of inverter circuit is the push-pull square-wave type, a typical arrangement being as in Fig. 1. Voltage and current waveforms vary considerably with the type of load, resistive, capacitative or inductive, and with a discharge lamp which has, among other things, a negative temperature-resistance characteristic, circuit operation becomes so complex that attempts to use this type of inverter with capacitative or resistive ballasts have only been partially successful.

A sine-wave, Class B inverter, of the single-ended type (Fig. 2), produces a better and more consistent waveform and has a theoretical efficiency of 78%, but in practice is more usually 50-55%. This can be improved by converting to Class C conditions by shunting the base resistor R_b with a suitable capacitor.

After detailing the design considerations of the components of these sine-wave inverters—the transistors, ballasts, transformers, capacitors, choice of operating frequency and the thermal considerations—the authors proceed to describe some practical lamp inverter circuits which have been developed.

The first of these is a single-ended inverter (Fig. 3) in which a "spill-over" circuit, comprising a winding with a similar number of turns to the primary winding, is connected in series with a rectifier across the d.c. supply. The function of this is to return energy, normally supplied to the transformer core on the conducting half-cycle, back to the supply should the lamp become disconnected, so preventing damage to the transistor.

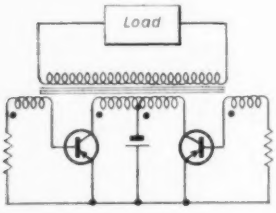


Fig. 1

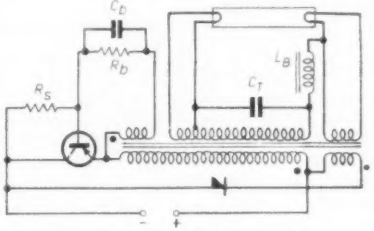


Fig. 3

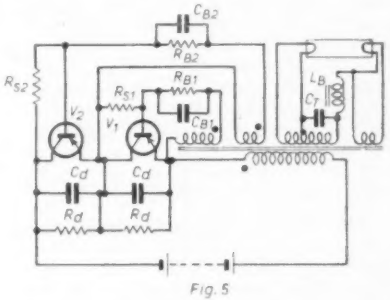


Fig. 5

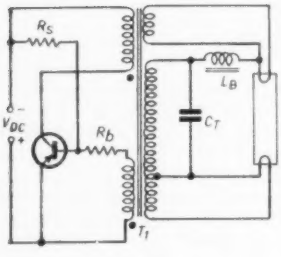


Fig. 2

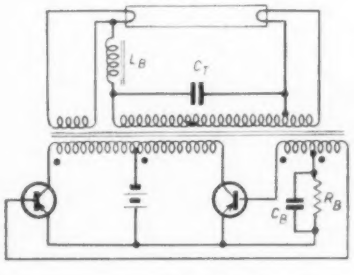


Fig. 4

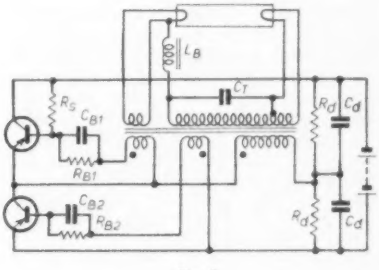


Fig. 6

Some circuits employing transistors for operating gas-discharge lamps from d.c.

In the push-pull inverter (Fig. 4) there are two transistors with separate biassing circuits, this arrangement enabling twice the power ouput to be obtained from a given d.c. voltage supply with improved lamp current waveform and reduced risk of excessive voltage swings on disconnection. Transistors may also be operated in series where the supply voltage is above the maximum for a single transistor (about 30 volts), and a circuit of this type for 60 volt operation is shown in Fig. 5. The base resistors R_{B1} and R_{B2} control both the drive on the transistors and the sharing of the voltage across them in the non-conducting half-cycle. Sharing of the direct voltage in the event of a non-start is ensured by connecting a starter resistor R_{S1} directly to the collector of transistor V_1 instead of to the negative side. This type of circuit has been made to operate up to 140 volts.

Split Battery Operation

A circuit incorporating two batteries in series or a single high voltage battery with a voltage divider across it is shown in Fig. 6. Here the transistors are safeguarded against excessive voltage but only half of the available d.c. voltage is applied across the transformer, so step-up ratios must be higher.

Precautions to be taken to protect the transistors when using square wave inverters are also mentioned and the use of an inverter for the provision of filament heating, where a number of short lamps in series are connected across a high voltage traction d.c. supply, is described. The use of *p-n-p-n* switches as a possible future development is forecast since this could enable inverters to be constructed which are independent of the type of load.

The reading was accompanied by a demonstration of a number of lighting installations using fluorescent tubes of different sizes and ratings operated from inverters of the kinds described in the paper. Some of these were production units which were in use in aircraft and public transport vehicles operating at frequencies from 1 to 15 kc/s; others were prototypes in course of development. In the former the transformers and ballasts were potted with a castor-oil-urethane plastic to suppress the noise created by magnetostrictive and constructional effects. The latter were in the open form and emitted a high pitched note which could be heard from every corner of the hall. The largest of the prototypes was a thyristor (*p-n-p-n*) inverter circuit driving twelve 5ft 80 W fluorescent tubes; the smallest, a unit for operating a 5 W 6 in. tube from a car battery.

The authors also showed the different stages of development in the unit now used on aircraft as a result of improvements in transistors over the past two years. The early units were, by comparison, bulky and tightly packed, necessitating extra cooling fins.

DISCUSSION

Mr L. J. Gardner (AEI Ltd.) remarked on the rapid development of transistor applications over the past two years. The transistors themselves were also making strides on the current side, but so far the same degree of development was not apparent on the voltage rating side. With germanium and silicon transistors it still seemed that 30-40 V d.c. was about the limit and above this, series arrangements were necessary. The noise factor at the high frequencies, as had been shown, could be a nuisance unless adequate silencing action were taken, not so much on account of the noise level as on the pitch which was irritating to the human ear. The problem of cooling was also important and the user would have to be educated into the proper placing of the units so as not to counter the maker's own cooling arrangements.

Mr Henkamp (Philips, Eindhoven) said that research on the development of the fluorescent lamp to attain higher efficiencies was going on throughout the world and it appeared that, with present phosphors, the limit of improvement had almost been reached. The extra 10 to 20% which was shown to be possible with the higher frequencies of these inverters would be most welcome. Although much had already been done in the design of the inverters, he thought that even more interesting developments would follow in the next few years.

Mr K. A. E. Salmon (AEI Ltd.) thought the paper made too much of the shortcomings of the square-wave inverter. He believed that it could be developed to give higher efficiencies than the sine-wave inverter if compromises in other aspects of design were made.

Mr G. Grimsdell (Mullard) suggested that, from the long-term view, it was almost certain that the thyristor, or *p-n-p-n* switch with thyratron like properties, would replace the power transistor in applications like those described. He thought that it would become an economic proposition at around the same price as germanium transistors before the silicon power transistors were available.

Mr G. M. Ward asked for a comparison between the economics of transistorised light sources and tungsten filament lamps. He had noticed the very great variations in the brilliance of lamps on the LPTB trains as it passed along the route. Would not these surges be harmful to transistorised fluorescent lighting?

Mr S. Anderson asked for a definition of the term "efficiency" in lighting with these devices. He thought that it should be in terms of input to output of the inverter and should disregard the luminous efficiency of the lamp.

Mr J. M. Waddell disagreed. The customer was interested in the light he got for a given current consumption. The proper interpretation was the lumen ouptut of the lamp per watt of input to the inverter. In passing, he raised the question of reliability. Only that morning he had travelled in one of the new diesel trains from Bedford to St. Pancras, the windows of which were plastered with notices apologising for the failure of the fluorescent lighting which, they said, was being installed for the first time. Were these the transistorised units? Or, perhaps, they used square wave inverters.

Mr N. Herwald also mentioned the use of the term efficiency. There was undoubtedly confusion on the term and an official definition was urgently necessary.

Mr Davies, replying, agreed with Mr Gardner that the biggest hope for the future was with the thyristor. In regard to the noise factor, the use of castor-oil-urethane potting materials had, as had been demonstrated, materially solved the silencing problem. The prototype inverters which had been shown without potted components gave a convincing comparison between silenced and unsilenced operation. He thanked Mr Henkamp for his views which were much along the lines of his own. In regard to Mr Salmon's comment, there might be something in what he said but, for his part, he was more inclined to favour Mr Grimsdell's view that the future, both on economic and technical grounds, would lie with the thyristor.

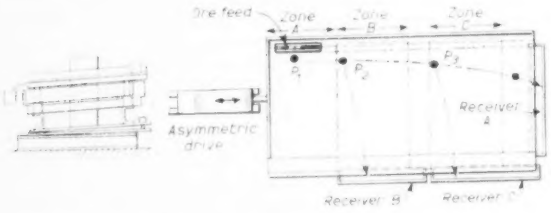
Mr Ward had asked for a comparison between the economics of transistorised light sources and tungsten filament lighting. This was a matter which would require some preparation and he would deal with it at length in his written reply. The capital cost of the inverters was high, but lamp replacements were much lower and, of course, luminous efficiency was greater with fluorescent lighting. In regard to the term "efficiency," he shared the views of Mr Waddell; there was, however, a need for a clear definition.

PROGRESS IN PATENTS

SELECTED SPECIFICATIONS

Magnetic Separation by A.C.

THE conventional type of magnetic separator which incorporates permanent magnets or electromagnets energised from a direct current source, when used in the separation of metalliferous ores, usually retains a fair percentage of non-magnetic metal and other inclusions which have been rendered partly magnetic by the presence of minute particles of magnetic material within or on them. Separation in these circumstances is, therefore, not so selective as could be wished and usually requires a second stage of refinement to exclude the non-magnetic constituents.



A.C. device for magnetic separation of ores

In an invention credited to Tadashi Ohyama and Saburo Yashima, of Sendai, Japan, which is described in patent specification 826,485, improved separation is achieved by the use of alternating current fields which are applied in such a manner as to divert the flow of particles to one side of a mechanically created line of movement according to the magnitude of their hysterisis loop areas.

The device comprises a table of non-magnetic material mounted on a frame in such a way that it can be reciprocated asymmetrically—that is, at a greater velocity on the return stroke than on the forward stroke—in a lateral direction. Below the table is placed one or more magnet systems comprising a series of adjacent horizontal poles energised from an a.c. source in a manner to produce a travelling field at right angles to the line of movement of the table. Further, the table is inclined at a slight angle in the direction of the travelling field.

As the ore progresses across the table diagonally under the influence of the asymmetric motion and tilt of the table, the magnetic particles are diverted at steeper angles down the slope by the travelling a.c. magnetic field. Particles with a large hysterisis loop area will take a steeper path than those with a small loop area and so will be selectively graded along the bottom edge of the table where they fall into receivers. Tailings are collected by a receiver at the end of the table. By using two or more magnet systems at different field strengths, improved separation is obtained with some ores. In the specification comparative figures are given for separation of magnetite and titanium ores by d.c. and a.c. methods to show the superiority of the a.c. system. The separator may be used under wet or dry conditions. For wet separation water in a fine spray is directed across the table to wash away low density non-magnetic particles.

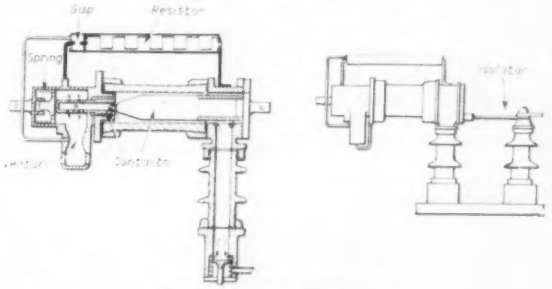
Liquid-break Circuit-breakers

Oil circuit-breakers, whether of high or low oil-content, almost invariably incorporate a means of forcibly injecting cool oil across the gap between the contacts on opening. In some designs the injection force is supplied by the springs which open or accelerate the contacts; in others, it is supplied from an external source such as compressed air or gas either directly applied to the surface of the oil or through a piston.

In a device described in patent specification 826,444, in the name of A. Reyrolle and Co. Ltd., the oil jet is initiated by an external cylinder containing a charge of oil under stored pressure provided by a spring-loaded piston held in the compressed position by a latch released by movement of the moving contact. On closing, the spring is reset by compressed air admitted to a second piston and cylinder co-axial with and connected to the first. The device may be located within the breaker tank.

Gas-blast Breakers

Patent specification 826,463, in the name of the BTH Co., London, describes a circuit-breaker in which an air-break isolator is interconnected with a gas-blast device for initially breaking the circuit and holding it open until the isolator has operated. Gas or air under pressure is admitted to the contact chamber where, by pressure on the surface of the spring-loaded moving contact, it



Gas-blast breaker and isolator

separates it from the fixed contact, the escaping gas removing the ionised air from the vicinity of the break.

The contacts are shunted by a current limiting resistor in series with an air-gap connected by pipeline with the throat of a venturi orifice in the escaping gas circuit. Should the arc restrike, the reduction of air-pressure in the vicinity of this gap will make it the preferential point for discharge when the current will then be limited by the resistor to a value which can safely be broken by the isolator. With the isolator fully open, the gas or air pressure is interrupted and the contacts in the gas-blast device reclose.

Reproduced by permission of the Controller of H.M. Stationery Office. Copies of specifications may be obtained from the Patent Office (Sales Branch), 25 Southampton Bldgs, W.C.2. Price 3s 6d.

Life of h.v. d.c. cables

INFLUENCE OF VOIDS AND STRESS ON DIELECTRIC

PERFORMANCE of dielectrics under a.c. voltage stresses are now fairly well understood and accordingly cable designs can be based on the considerable data which has been accumulated since high voltage a.c. cables were introduced. Similar information has not been available for insulation performance under d.c. stresses, but with the decision to use a d.c. high voltage cross-channel link and with several other schemes in prospect, obtaining such information has become important.

The phenomena of gaseous discharge in cable dielectrics under high d.c. stresses formed the subject of a paper presented to the IEE last week.* The paper describes mathematical and experimental techniques developed to assess the rate at which discharges are likely to occur across voids in a dielectric subjected to d.c. stress. It has long been established that such discharges have a bearing on the life of a.c. cables and the same effect is therefore likely to be important on d.c. cables even though the discharges are of a quite different nature.

When the discharge inception voltage across a void in an a.c. cable is exceeded, discharges occur at a minimum value of 100 per second with a 50 c/s applied voltage and this rate will increase if the stress is raised. Under d.c. stress the discharge process is quite different. As the d.c. stress is increased from zero to a steady value there is a rapid succession of discharges. If the dielectric had infinite resistance and with a steady stress maintained, no further discharges would occur. Since dielectrics do not have infinite resistance, further discharges do take place, but at a much reduced rate determined by the time taken for charges to accumulate on the void walls. Although the discharge rate is likely to be very much less than with a.c., it is probable that the damaging effect on the dielectric will still be far from negligible.

Stress Distribution

The stress distribution in the dielectric of d.c. and a.c. cables differs fundamentally. In a dielectric subjected to a.c. stress, the distribution is determined by permittivity and, since this varies little with either applied stress or temperature, distribution is little affected by change of temperature or load. Under d.c. stress, however, distribution is governed by the dielectric conductivity and, since this varies with temperature and stress, the stress distribution will change with variations in load and temperature. Conductivity of the dielectric rises appreciably when both temperature and stress increase, although the paper shows that the two variations are independent. For a temperature rise from 30 to 100°C, the dielectric conductivity of a paper impregnated with petroleum jelly rises from 10^{-16} to 10^{-13} mho/metre at a stress of 20 kV/cm.

Since this temperature rise will occur near the conductor the effect is to reduce stress at the conductor surface and increase it in the region of the sheath. In combination with the increase of conductivity with increasing stress, this effect may result in stress inversion giving a stress near the cable sheath exceeding that at the conductor. Although this effect results in higher stressing where the insulation is cooler and therefore intrinsically stronger, too great an inversion may produce difficulties in joint design. A satisfactory dielectric for d.c. cables should have low thermal resistivity as well as low electrical conductivity over the working temperature range of the cable to ensure good stress distribution. These properties should vary little with temperature changes, but several other factors must also be considered. Factors which will also decide the effectiveness of the dielectric are d.c. breakdown and impulse strengths, and the mechanism of long-term deterioration under stress. Electrochemical action may also be significant and for rubber and plastics materials which could possibly be used without an external sheath, water absorption will also be important.

Possible Dielectrics

Availability of experience with a.c. operation over many years suggests impregnated paper as the first choice dielectric under d.c. conditions, but polythene also has many important attributes to ensure good stress distribution. Data available on impregnated paper performance with a.c. together with limited information of d.c. operation suggest that working stresses between 150 and 220 kV/cm at the conductor will give satisfactory operation. Little information is available on relative merits of solid and pressure-assisted dielectrics, although Swedish tests on solid insulation indicate that breakdown stress may be 300-400 kV/cm, while with oil filling breakdown stress may rise to 500-600 kV/cm. The Swedish tests were conducted with the cables forming an inverted U and the lower value for the solid impregnation suggests that voids forming at the bend may have accelerated breakdown.

Polythene also has a low thermal resistivity which is favourable to high current rating and satisfactory stress distribution. Its electrical properties are little effected by immersion in water, but it has relatively low impulse and short-time d.c. breakdown strengths, although strengths varying from 500 kV to 7,000 kV/cm have been recorded. It is also vulnerable to discharge damage and so far it has not been possible to devise an extrusion process to give a dielectric free from voids. This factor has prevented its use so far at circuits voltage much greater than 33 kV. Under d.c. conditions a mean stress of 150 kV/cm could probably be used but the liability to discharge damage in voids be a limitation. Polythene was selected by the authors to verify experimentally the results of their theoretical analysis of discharge in voids because in this material the effect of such discharges is of importance and also because its translucent properties permit an optical method of discharge detection.

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* Paper S.3144: "Gaseous discharge phenomena in high voltage d.c. cable dielectrics." E. C. Rogers, M.SC., A.INST.P., A.M.I.E.E., and D. J. Skipper, B.SC.(ENG.), A.M.I.E.E. Mr Rogers is with BICC and Mr Skipper with the CEGB.

Several other materials which could be used for d.c. dielectrics are subject to limitations. Terylene and polystyrene are two materials having satisfactory electrical properties, but their cost at present is likely to preclude their use. Butyl rubber has conductivity and stress characteristics which vary satisfactorily with temperature to give reasonable stress distribution on load, but its limitation lies in a d.c. strength of 400 kV/cm or little more than one-third that of impregnated paper and which is liable to fall with prolonged immersion in water.

Polyvinyl chloride is unlikely to be suitable as a dielectric for h.v. d.c. cables. Its conductivity is markedly influenced by the amount of plasticiser used and it is also considerably affected by temperature variations. Stress, however, is little affected by temperature and as a result stress inversion is likely to occur on load. The high thermal resistivity would also limit the current carrying capacity of a cable. A further disadvantage of p.v.c. is the increase in conductivity occurring with immersion in water, which could lead to insulation failure by electrochemical action at relatively low stresses.

Discharge in Voids

The authors give a mathematical theory for determining the repetition rate of discharges in a dielectric void when subjected to d.c. stress. The theory assumes an oblate spheroid for the cavity shape having zero conductivity and in an appendix it is shown that zero conductivity of the void walls corresponds to the condition of maximum discharge repetition rate.

The theoretical treatment was shown to be reasonably consistent with experimental results obtained on samples of polythene. In these experiments a void $\frac{1}{8}$ in. diameter was artificially created in a 0·005 cm thick polythene sheet. Sheets of similar thickness were placed on either side of the voided sheet and the assembly subjected to d.c. stress for several days. A record of discharges in the void was obtained by a photomultiplier counter operated by light emitted during the discharges and which passed through the translucent polythene into a light sealed box. The method was developed as a more sensitive indication than the detection of incremental change in voltage over a sample which has been used in the past and which is subject to electrical interference.

Damage to the dielectric resulting from discharges in a void is probably dependent on the stress in the dielectric and the magnitude of the discharge. If it can be assumed that the frequency of discharge in the void does not of itself influence the amount of damage, then accelerated life tests using a.c. can be used to provide a useful guide to probable life under d.c. stress.

A factor which must be considered in designing such accelerated tests is possible change in the void structure as a result of the discharges within it. Changes in conductivity of the void walls may result in discharges becoming temporarily extinguished or intermittent. However, cavities adjacent to a conductor are unlikely to be affected in this way, and this is therefore the most suitable type of void on which to conduct accelerated tests.

Tests conducted on one particular polythene compound with voids adjacent to a conductor at 50 c/s stresses two or three times the discharge inception voltage showed that at temperatures of 65°C a life of at least 600 hours could be expected with stresses exceeding 150 kV/cm.

Tests conducted show that the discharge repetition rate in a cable void exceeds the steady state value which might be anticipated for several hours after the stress is first applied, partly due to change in volume conductivity. On the cross-Channel cable it is proposed to reverse polarity to enable power to be transmitted in either direction and, as this may occur several times per day, it is possible that the average discharge repetition rate may exceed the steady state value with consequent reduction in cable life. A further possible cause of increased discharge repetition rate would be ripple voltage superimposed on the d.c., but it seems likely that the factor of safety to comply with working conditions would be adequate to allow for these two effects provided the dielectric was not subject to undue damage during laying.

DISCUSSION

Mr R. Davis (NPL) thought that d.c. had wider applications than submarine links. Impregnated paper still appeared the most satisfactory dielectric; polythene could possibly be used without a waterproof sheath but were extrusion techniques developed to eliminate voids? The photo-electric technique was limited to the few translucent dielectrics and did not seem to give discharge magnitude.

Mr C. C. Garton (ERA) complimented the authors on their mathematical solution but queried whether sensitivity of the photo detection method was better than the double-screened-room technique developed by ERA. He emphasised dangers of large voids during extrusion which required monitoring during manufacture for their detection.

Mr C. C. Barnes (CEGB) thought that terylene and polystyrene should not be dismissed merely because of high cost. He thought the approach should be to search for a plastics with suitable electrical properties rather than test materials which happened to exist. The authors were cautious in their estimate of polythene's use for submarine cables.

Mr E. L. Davey (BICC): Polythene seemed to be the most promising dielectric, but the presence of voids was its obvious weakness. Hydrostatic pressure exerted on submarine cables would tend to eliminate such voids.

Mr R. C. Mildner (TC and M) asked if the authors had checked the number of discharge sites after the tests and the discharge initiation voltage. The authors theory confirmed his own findings that discharge repetition rate was in terms of hours rather than days, as had been previously thought. He did not think that discharge energy necessarily increased with void size.

Dr B. F. Salvage (Leeds University) thought that comparative variations of discharge repetition rate and conductivity with temperature would have been useful. Had the authors followed the degradation process occurring at void walls?

Mr J. H. Mason (ERA) did not consider the mathematics justified since it had been previously shown that cavities were of irregular shape and had many discharge sites. He thought attenuation of light from the discharges by polythene would possibly result in some not being recorded. The authors suggested that discharges in voids adjacent to a conductor were unlikely to be extinguished, but work at ERA had shown that they were frequently short-circuited by carbonisation.

Mr J. E. L. Robinson (chairman) said the equations suggested that the repetition rate was independent of void size. He asked if the authors had applied the theory to voids adjacent to a conductor.

Mr G. S. Buckingham (MEB) commented on the very long life predicted by the authors for polythene insulated cables and asked if any work had been done on interleaved paper-impregnated and polythene tapes.

Mr D. J. Skipper, in reply, said emphasis had been given to submarine cables because they were the first application to h.v.d.c. He agreed large voids were of great importance and required continuous monitoring during extrusion for detection. Polythene extrusion was at present limited to about 0·3 in., but this should be satisfactory for cables working at 200 kV. Both polystyrene and terylene had electrical characteristics which could lead to stress inversion on load. He felt that although work could be extended, their experiments had confirmed the theory. The photo multiplier technique had been checked by other methods and discharge sites in voids had been checked after testing.

Oil switches for metalclad boards

CABLE feeders forming part of either a ring main or spur distribution system will generally be connected to transformers or similar equipment requiring occasional isolation for maintenance purposes and which may also be subject to infrequent switching operations. For such cable feeders, where suitable back-up circuit-breaker protection is available, oil switches introduced by Johnson and Phillips are likely to be of particular value. These triple pole switches have main and earthing blades interlocked to prevent incorrect operation, and so arranged that with main blades open it is possible to insert cable testing plugs through an interlocked safey cover above the switch compartment.

Oil switches type SX are intended for a normal rating of 400 A and have been fully tested to BS 2631 for load breaking at 120 A and 520 A and also for fault making on main and earth contacts. Fault capacity tests have been conducted at KEMA laboratories and the switches have been certified for 250 MVA at 6·6 and 11 kV and also for 350 MVA at 11 kV.

Construction

The switch consists of three compartments, the upper constituting either an air-insulated or compound-filled busbar chamber, and the lower a cable box for outgoing connections. Three bushings link the cable box to the central switch compartment. These bushings, which may be either epoxy resin or bakelised paper, carry the switch blades on their copper inserts. Main and earthing blades are operated through linkages by a manually initiated spring mechanism. The front cover opens to give the attendant access for operation of both main and earthing switches by a removable handle. The switches can be padlocked. The oil switch is suitable for mounting in the company's metalclad boards and has the same width as their circuit-breaker, 1 ft 9½ in., permitting the two units to be interchanged with little difficulty or rearrangement.

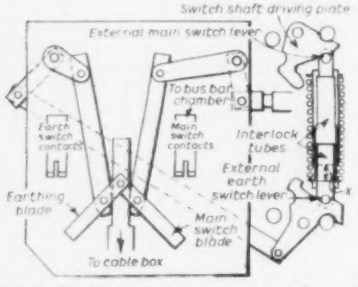


Fig. 1. Diagrammatic representation of switch action with earth and main blades open. The spring ensures a sharp closing action on both earth and main contacts. The space X between the two interlock tubes is restricted to prevent both switch blades being closed together

A feature of the switch design is the single spring which actuates both main and earthing blades through a mechanism which ensures that although both sets of blades may be opened together, they cannot be closed together. The spring also gives a sharp closing action to both sets of blades which cannot be influenced by the operator. Both switch blades pivot on their supporting bushing insert. Contact is maintained at the pivot by springs held between brass collars, machined to give the designed spring compression. The arrangement permits quick reassembly after maintenance without need for resetting the springs.

Cable testing plugs are inserted through an interlocked cover above the switch compartment. It is not possible to open the cover with the main contacts closed, or to close the main contacts with it open. The plugs can only be inserted with the cable earthed and when the earthing switch is opened, they are trapped in position. They can only be released by subsequent reclosure of the earthing switch.

The busbars and switch are assembled as a single structure suitable for building into a switchboard. Cable entries can be provided for any direction or to customer's requirements. The switch is robustly built and has an oil capacity of 8 gallons.

INTERNATIONAL STANDARDS ADVANCE

SOME important committee meetings of the International Electro-technical Commission which took place towards the end of 1959 were concerned with large generators, with carbon brushes, and with instrument transformers. In the first of these fields, agreement was reached on recommendations to be made for new preferred standards for 3,000 r.p.m., 50 c/s machines, and on the question of temperature rises in such machines, which have been affected by changes in methods of cooling. Documents are to be circulated for the approval of IEC national committees.

Another generator topic discussed was a proposal to standardise methods for determination of constants of synchronous machines and waveform irregularities in generators. A new subcommittee is to discuss the former question further, with a view to preparing an IEC recommendation. The second subject is to remain under discussion.

Brush gear

On carbon brushes, the main business was consideration of a draft for the dimensions of brushes and brush holders; and this is to go forward for approval. New work agreed will cover standardisation of nomenclature for brushes and related components of electrical machines. Consideration is also being given to further standardisation of brushes and brush gear, with attention to brush chamfers and angles of contact, and top bevels. Lengths of flexible conductors are to be looked into, and the diameter of terminals receiving these.

The transformer sub-committee has completed the first section of a comprehensive revision of the existing IEC standard to cover voltage, current and capacitor voltage transformers. A draft on current transformers is ready for circulation to national committees, one on voltage transformers is at an advanced stage of preparation, and proposals for the section on capacitor voltage transformers is to be undertaken by the UK secretariat shortly.

Equipment approval

Also active during the same period were sections of the CEE (International Commission on Rules for the Approval of Electrical Equipment). It was this which discussed the proposal for a green/yellow standard colour for earthing core of portable appliances, to overcome the difficulty experienced in the export field due to different European countries having different colour codes.

The British delegation at this discussion made it clear that it would not be possible for the UK to depart from its practice of using green as the identifying colour for the earthing core. However, they expressed the hope that the Wiring Regulations Committee of the IEE would be able to recognise green/yellow as an alternative to green alone, so far as imported products were concerned. It became clear at the meeting that the green/yellow combination would be accepted during the next few years by all other CEE member countries, either as an alternative to their present practice or as the sole national standard.

Another topic of wide interest was a proposal for gauges for Edison-screw lamp-caps and holders. Varying lengths of caps and holders on the Continent had presented difficulties, but delegates agreed to accept gauges proposed by the IEC with slight changes to take account of Swedish safety standards for holders.

Other work going forward within CEE includes a specification for appliance couplers (the British delegation is under pressure to accept non-interchangeability with continental double-pin plugs as a feature), switches for building into appliances, and motor-driven appliances.

More Power in Works' Electrical Generation

FACTORS INVOLVED IN INSTALLATION OF NEW 4 MW SET BY BOOTS

THAT large scale steam production for use in processes lends itself to the generation of electricity as a by-product is a common enough aspect of industry. The main difficulty arises in making reliable estimates of its cost, when it is being considered as an alternative to importing power from a public supply. Such a problem recently faced the Boots Pure Drug Co. Ltd. at their works at Beeston, near Nottingham, where the choice lay between augmenting an existing private generating capacity of 8·75 MW or arranging for a public supply, in order to meet power demands which were approaching their own available capacity.

The existing power station dates from the late twenties, when their first three turbo-alternator sets were installed: two of 1 MW capacity and the other of 0·75 MW capacity, all generating at 400 V. The two larger sets were of the back-pressure type, exhausting to a process steam main at a pressure of 60 lb/sq in.; the other was a condensing type. A fourth, pass-out set, of 1·5 MW, was added a few years later, and a fifth, also pass-out but of 4·5 MW rating, generating at 11 kV, during the war.

The electrical system was at that time operated in parallel with the public supply. The firm had freedom to import or export power as required, thus enabling them to run at optimum efficiency on both steam and electric loads at all times. This link was later broken, and the works runs entirely independent of the public supply system.

Overall Supply System

The Beeston power station is linked with another Boots power station at their Nottingham works. Originally, the interconnection comprised a 0·04 sq in., 11 kV cable, feeding a 500 kW motor generator set at Nottingham. In emergencies, the power flow could be reversed, giving a maximum load of 300 kW in this condition. The interconnection has been augmented since the war by a 0·1 sq in. cable, which was provided when two new 1·5 MW turbo-alternator sets were installed at Nottingham to replace existing plant dating from the first world war.

The new interconnector was arranged to form a ring with the existing cable to supply two substations at Nottingham, four at Beeston, together with another Boots factory between the two. In all, their 11 kV system serves nine transforming substations.

During the last ten years demand for both steam and electricity has risen considerably at both Beeston and Nottingham. The demand for electricity is growing at a greater rate and has, in fact, doubled during this period, having risen by 60% between 1948 and 1952 and by 40% from 1954 to 1958. The major electrical load (about 80% of the total) is used to power motors ranging in size from ¼ to 5 h.p.; the largest motor in productive use is less than 50 h.p.

Costs of Generation

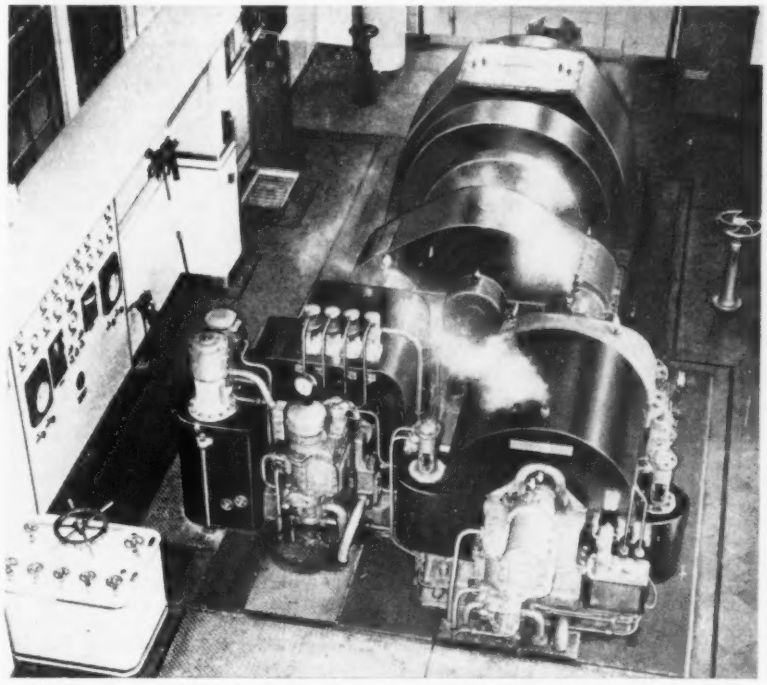
In view of the firm's general use of pass-out or back-pressure turbo-alternator sets to make use of the latent heat in the steam after it has passed through the turbine, a high overall efficiency is achieved. Taking all factors into account, the thermal efficiency reached is between 60% and 70%.

One of the important features of this efficiency is a comparatively low cost, judged in terms of private generation, for their electricity. Total cost to Boots during the past 12 months has averaged approximately 1·5d/unit.

The steam from the turbines is also used in both factories for space heating as well as process heating. At Beeston, more than half the steam is used for processes, even during winter months. At Nottingham, about 40% is used for this purpose, the remainder for space heating.

Costs of New Plant

In augmenting the power supply to their factories, the choice lay, obviously, between a new turbo-alternator set and public supply. From the capital cost aspect importing power to meet the growing demand would have required the erection of a new substation which in turn would have involved alterations to the distribution system. Total cost of both was estimated at between £40,000 and £50,000. To install a new turbo-alternator of between 4 and 6 MW capacity would incur a capital outlay of somewhat more than £100,000, apart from any additional cost for extending the power station, which was estimated at adding an extra £20,000.



New W. H. Allen, 4 MW cross-compound pass-out turbo-alternator set installed at the Beeston works power station of the Boots Pure Drug Co. It occupies only little more than the space of the 30 year-old 1 MW alternator set it replaced

The final decision was for a new turbo-alternator set, of a 4 MW rating. The turbine is a twin-cylinder, cross-compound, pass-out condensing machine manufactured by W. H. Allen and Sons Ltd. and the compact design of these units is such that the complete set was installed in only little more the space occupied by one of the original 1 MW sets it replaces. In this way, it was possible to avoid extending the building which would have been required with a more conventional in-line set.

The new set has a h.p. turbine running at 6,000 r.p.m. and a l.p. turbine running at 4,000 r.p.m. Both are geared to the BTH alternator, which runs at 1,000 r.p.m. In common with the set installed during the war, it generates at 11 kV, 0·8 p.f. and has air/water cooling. This replacement keeps the number of sets at Beeston at five, whilst increasing the installed capacity to 11·75 MW, excluding the 3 MW at Nottingham.

Cost of the additional unit was about £110,000 and although this is twice as high as the capital cost estimated for obtaining a public supply, Boots have indicated that the saving in cost of generated compared with purchased electricity gives an adequate return on the capital outlay. Details have not been given, but it seems that they find it cheaper by several thousand pounds per annum to install their own plant.

Other requirements for generation are conveniently at hand. Cooling water for Beeston (2,000 million gall in 12 months) is pumped from the nearby Trent navigation canal and returned further downstream. At Nottingham, most of the supply comes from their own boreholes. Coal consumption at Beeston is about 47,000 ton per year; at Nottingham, 17,000 ton. The entire supply comes from local coalfields, one of which extends to within a few hundred yards of the Beeston works.

ELECTRONIC AIDS TO MOTOR TESTING

American Experience with New Equipment for Production and Repair

DURING the construction or repair of electric motors the variety of instruments used for the determination of the quality and characteristics of the materials, the checking of components in various stages of assembly, and the testing of the completed motor, is quite considerable. In many cases the instruments and the methods of test are those which have been used with little change over the years. In recent times there has been a move towards the development of electronic methods and instruments for tests which cannot reliably be achieved by any other means or for those which can be carried out more efficiently or speedily.

This trend is, perhaps, more advanced in America where industry is inclined to think in terms of "electronics" whenever possible. In a paper read before the fourteenth annual Instrument Automation Conference at Chicago last autumn, A. E. Hartman, E. M. Sawyer and G. V. Mueller, of Robbins and Myers Inc., Springfield, described some of the devices and methods which have been applied with success.

Electronic Rev. Counting

As an alternative to the use of rev-counter and stopwatch, an electronic counter has been devised for measuring the output frequency of a magnetic pick-up, coupled to the motor shaft, which generates 60 impulses per revolution. The counter averages the number of impulses per second and displays this in digital form as r.p.m.

The same pick-up can be used in conjunction with a cathode-ray oscilloscope and camera to give a record of speed variations during starting up or under sudden changes of load, the variable frequency signal being converted to a variable voltage applied to one pair of plates against a time-base signal across the other pair.

As a further step, a flywheel can be coupled to the motor shaft, which will extend the period from start to full speed and, since the moment of inertia of the flywheel can be calculated, the relationship between motor torque and speed during running-up can be determined with accuracy.

Torque Speed Curves

From the above results a torque-speed curve can be constructed but it is also possible to display the curve direct on a c.r.o. and to photograph it as a permanent record. To achieve this two voltage signals are required, one of which is directly proportional to the speed and the other to rate of change of speed. This provides a measure of shaft acceleration, which is closely proportional to the torque developed. These conversions are easily obtained by established electronic circuits.

For larger motors an alternative form of signal generator, or "transducer," is a small two-phase squirrel-cage induction motor coupled to the shaft of the motor under test. By energising one winding from a constant voltage, constant frequency supply, the output from the second winding will also be at constant frequency but at a voltage directly proportional to the speed of the motor. Again, voltage and rate-of-change signals can be used to show a torque-speed curve on a c.r.o.

Starting Time

The measurement of the period from the switching on of current to the time at which the motor has reached a predetermined speed can be effected, in the case of three-phase induction motors, by an electronic timer monitoring the current in one of the windings.

It is, of course, appreciated that the initial current on starting is high and falls rapidly to a no-load value as the rotor speeds up. The timer is set to start on the initial surge of current and to stop when it has fallen to the no-load value.

The temperature rise in the windings with various loads is measured by thermo-couples inserted in the windings and coupled to a recorder. The load is applied by an eddy-current brake or dynamometer and the usual method is visually to monitor both voltage and current and to make such adjustments as may be necessary to the brake or dynamometer setting to compensate for variations in voltage or resistance of the windings through changes of temperature. Today this can be done with greater accuracy and speed, by electronic control of the brake setting, at some saving in time and cost.

Surge Testing of Windings

The testing of windings for defects, particularly with repaired motors, is always a problem whether it be for field or d.c. armature windings in that small variations difficult to detect by conventional methods may have considerable effect on the finished motor. Moreover, over-voltage tests do not always detect incipient weaknesses in insulation and may even weaken an otherwise healthy condition.

An electronic surge tester developed by Dr Herman R. Weed of the Electrical Engineering Dept., Ohio State University, applies a transient voltage from the terminals of a charged capacitor and compares the c.r.o. trace with that from a healthy winding of similar characteristics. The magnitude of the capacitor voltage is adjustable from 1 to 10 kV and the charge and discharge is controlled by a thyratron firing device which transfers the impulse from the test standard to the winding under test sequentially, the two traces appearing superimposed for comparison.

In another form, similarly charged identical capacitors are connected simultaneously across the two windings and the traces compared together. In yet another form the traces are applied, one to each pair of plates in the c.r.o. to produce a straight line trace where the resultant transients are identical or a deviation where they are not. This detects variations of as little as 5%.

LIMIT SWITCH SAFETY

Design should always provide positive mechanical operation

LIMIT switches are applied so widely in industry, either for controlling a production sequence or as part of a safety system, that requirements for their safe and reliable operation might easily be overlooked. A reminder of these requirements is provided in the Factory Inspectorate's Report* on electrical accidents in 1958. It deals in a usefully practical manner with the essentials of limit switches and interlocks, and also gives guidance on associated circuit design to avoid sneak circuits.

The first requirement for a limit switch is that it shall not fail to operate or, in other words, its operation must be positive. Examples of positive and non-positive operation are provided in Fig. 1, which illustrates a typical cam and roller-operated limit switch. In the arrangement shown in A_1 and A_2, the switch is forced into the open, or safe, position by the rotation of the cam; in B_1 and B_2, however, the limit operation is not positive, since the arrangement relies on gravity or an internal spring, to lower the plunger and open the switch. Such an arrangement may readily be defeated (as shown in C and D) either by means of a wedge inserted between cam and roller to hold the switch closed or as a result of the switch jamming in the closed position.

Spring-assisted Operation

In many cases, however, a simple opening action implied in Fig. 1 is inadmissable because the speed of switch operation may be insufficient; usually the contacts are spring-operated to obtain a quick break. Such switches should still incorporate a positive follow-up to guard against weakening or fracture of the spring. In other words, should the spring fail, there will still be mechanical opening of the contacts. The application of a positive follow-up to a snap-action limit switch is depicted in Fig. 3.

It is important that the switch or the associated moving parts by which it is actuated should be arranged so that this mechanical follow-up takes place at every switch operation. The spring is therefore employed solely to give a quick break and reliance is placed on the positive mechanical action to hold the switch open. An instance is cited where, on a crane overwind limit switch, the lift applied to the switch was sufficent only to obtain spring opening and did not complete the opening operation mechanically. The switch operated successfully for several years until the spring weakened and failed to open the switch. As the mechanical follow-up position was never attained, the crane overwound and the resulting rope breakage caused a fatal accident.

Whilst ensuring that the switch is opened, or held open, by a positive mechanical movement, the operating mechanism must not, of course, be so arranged so that it moves the closing mechanism too far and damages the switch. This requirement is particularly important where limit switches are used to stop a machine. It can be achieved, for example, by profiling the cam so that the working surface has a constant radius once the open position has been reached or by providing a level portion on a ramp. It should be designed, however, to accept a reasonable amount of overtravel without damage.

Apart from safeguarding against spring failure, the design should ensure that the limit switch is not rendered inoperative by the failure of a small part such as a split pin or adjusting screw. An example to illustrate this principle is shown in Fig. 2, which represents a limit switch of robust construction, here operated by a roller on a radial arm, and held closed by a leaf spring. With the contacts arranged as shown, failure of the pin holding the moving contact strip to its arm will cause the switch to open and thus fail to safety. Were the contact arrangement to be reversed (i.e., the moving contact above the fixed contacts) failure of the screw would result in the strip dropping down onto the contacts to close the switch and create danger.

Interlocks

Where possible, it is always preferable to use a positive mechanical interlock between a guard and the main switch or isolator, rather than a limit switch. The interlock can be quite simply constructed; Fig. 4 shows how two bars, two discs, or a bar and a disc can be slotted so that whilst one is moved, the other must remain fixed. With such devices, it is easy to arrange that while the switch is open the guard must remain closed and that while the guard is open the switch cannot be closed.

There are other methods of achieving the same end, of course. One makes use of a rod which slides into a hole in a bar attached to the guard. It is also possible to provide a projection on a guard which interlocks with the handle of an industrial ironclad switch suitably placed.

* This document, available from HMSO at 5s, was reported more comprehensively in our issue of 7 January, 1960. The present article is concerned in greater detail with the report's comments on limit switches and interlocks.

Fig. 1

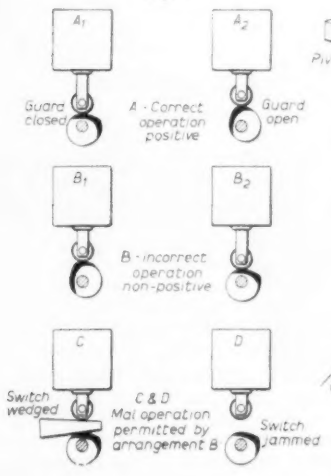


Fig. 2

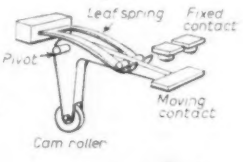


Fig. 3

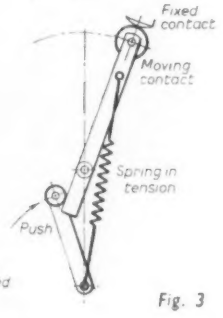


Fig. 1. Typical plunger limit switch actuated by cam and roller, showing positive and non-positive operation

Fig. 2. Simple limit switch operated by a roller on a radial arm, held closed by a leaf spring

Fig. 3. Spring incorporated in limit switch to give snap action, backed up by positive mechanical operation

Fig. 4. Some simple, robust arrangements of bars and discs to provide interlocking

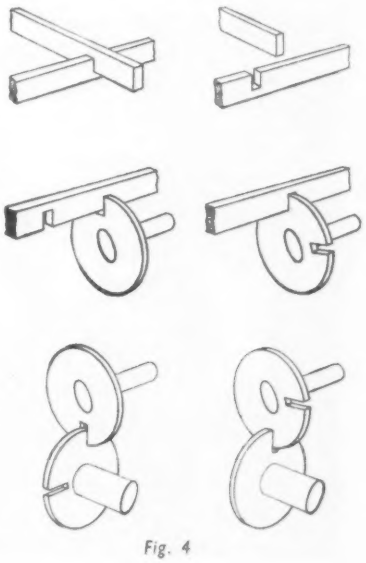


Fig. 4

Do Defects in Welds Matter?

ISOLATED FLAWS MAY HAVE LESS SERIOUS EFFECT THAN REPAIRS

WELDING is a subject which has a twofold interest for the electrical engineer. In the first case the ever extending use of arc welding in industry presents a constant challenge to the designer of such equipment and, secondly, welding plays a large part in the fabrication of electrical equipment these days.

It is recognised that both arc and gas welding alike are operations calling for considerable skill and care on the part of the welder. Post-welding inspection may disclose blemishes and defects visible to the naked eye or beneath the surface by X-ray, magnetic or other form of detection. To what extent are these defects of significance and how far is it necessary to rectify them?

This was the subject of an interesting informal discussion at the Society of Non-Destructive Examination in London on 4 Dec., when Dr Richard Weck, Director of the British Welding Research Association, gave his views. He began by saying that this was a most complex question to which he could not be expected to give a simple answer. The subject was incompletely understood and there was need for much more research of a fundamental nature as well as for more data on failures in service. The BWRA is actively studying the subject.

It was necessary to differentiate—and here he was confining himself to mechanical and not electrical or magnetic aspects—between weld defects which were to be subject to static loading and those which were to withstand fatigue conditions arising out of cyclic loads.

The defect could be considered as a reduction in the cross section or load-bearing area which would produce an increase of stress, average or nominal, dependent on the size of the defect. Unless the area of the defect was very large, it could be ignored.

The defect could, however, produce a concentration of stresses which might even then be unimportant if the material was sufficiently ductile and the loading was static but where the material was being used below its transition temperature, the defect might play an important part in the initiation of brittle fracture.

Under conditions of fatigue or cyclic overloading the presence of stress concentrations around defects might well result in premature fatigue cracks with risk of early failure. Despite this, small isolated pockets of porosity could well have less effect than a repair in the form of a cutting out and re-welding, since the latter might introduce internal sharp corners and discontinuities which had been shown to be capable of doing more harm than the defect which had been removed. Small internal defects which needed elaborate equipment to detect were probably of least importance.

Heat treatment to remove stress concentrations after welding might not always be advisable. The presence of a compressive stress concentration might be beneficial; a tensile stress concentration adjacent to a defect could be most harmful and stress relieving in these circumstances was to be recommended. The complexity arose in that it was not easy to distinguish between compressive and tensile stress concentrations.

On the subject of acceptance codes, Dr Weck expressed himself as being opposed to them since the basic information available was insufficient to justify their drafting and no code could be a substitute for a properly trained and experienced inspection engineer.

PACKAGED SUBSTATION SAVES SPACE

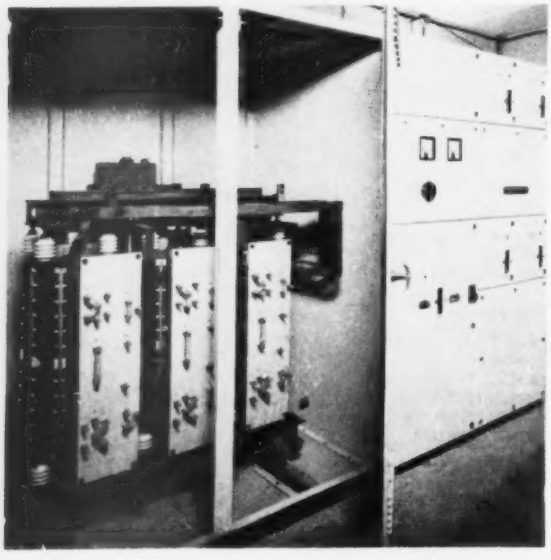
WHEREVER an industrial electrical system is so widespread as to require substantial copper in the m.v. cables, considerable savings in capital costs and cable losses can be made by siting a substation at some convenient point where h.v. supply can be stepped down and distributed radially.

In considering such a system from the economic standpoint, the cost of the substation has to be set off against the savings in m.v. cables, etc., and it is often the case that the price of transformers, switchgear and busbars of conventional pattern is high enough to tilt the balance against a system which would otherwise have seemed economic.

To meet such situations the English Electric Co. has developed a "packaged" substation comprising adjacently coupled transformer and medium voltage switchboard in a sheet steel enclosure, but without h.v. switchgear, in which costs have been reduced considerably without sacrificing reliability or flexibility. The transformer, up to 750 kVA rating, is of the "dry" type adequately cooled by air circulation through louvres on three sides of the transformer compartment. Without oil present, fire risks are reduced and no fire protection is required. Insurance premiums may also be reduced.

The transformer is mounted on rollers and may be replaced by units of different capacity with the minimum of disorganisation and time. The adjacent medium voltage distribution board will accommodate up to five outgoing feeder switches and the transformer switch, the whole being totally enclosed with interlocks on the doors which trip the h.v. breaker and isolate the unit immediately they are opened. The h.v. breaker may be mounted adjacent to the substation or on a distant board.

Attention has also been given to weight which has been kept down with a view to making it suitable for mounting within the roof girders of a factory where floor space is at a premium.



English Electric packaged substation of 250 kV rating installed at Mersey Docks and Harbour Board, eventually to be increased to 500 kVA. A similar unit of 500 kVA is shortly to be installed at Huntley and Palmers at their Huyton works

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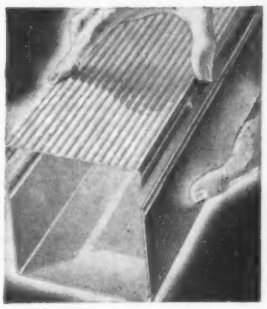
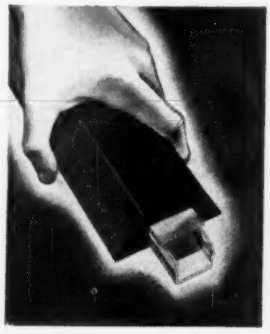


CHANNEL *Spring Capped* CONDUIT



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PANCAKE TRADE MARK BRITISH PATENT NO. 777282 *over-floor* DUCTING

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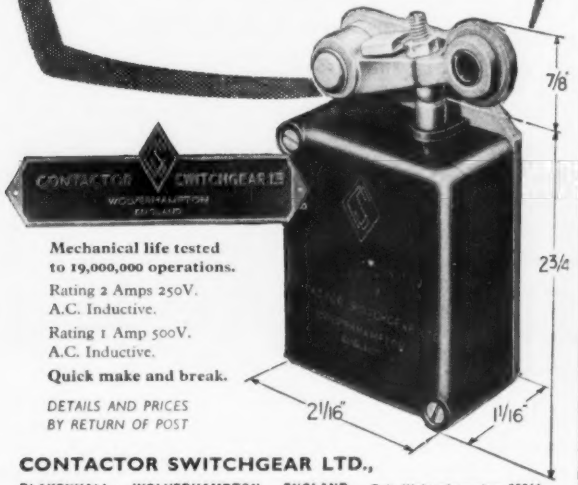

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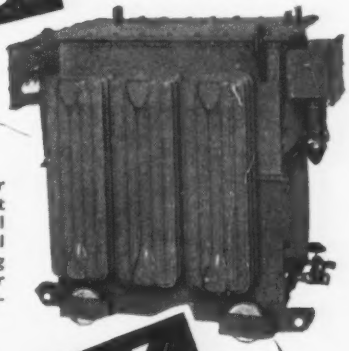

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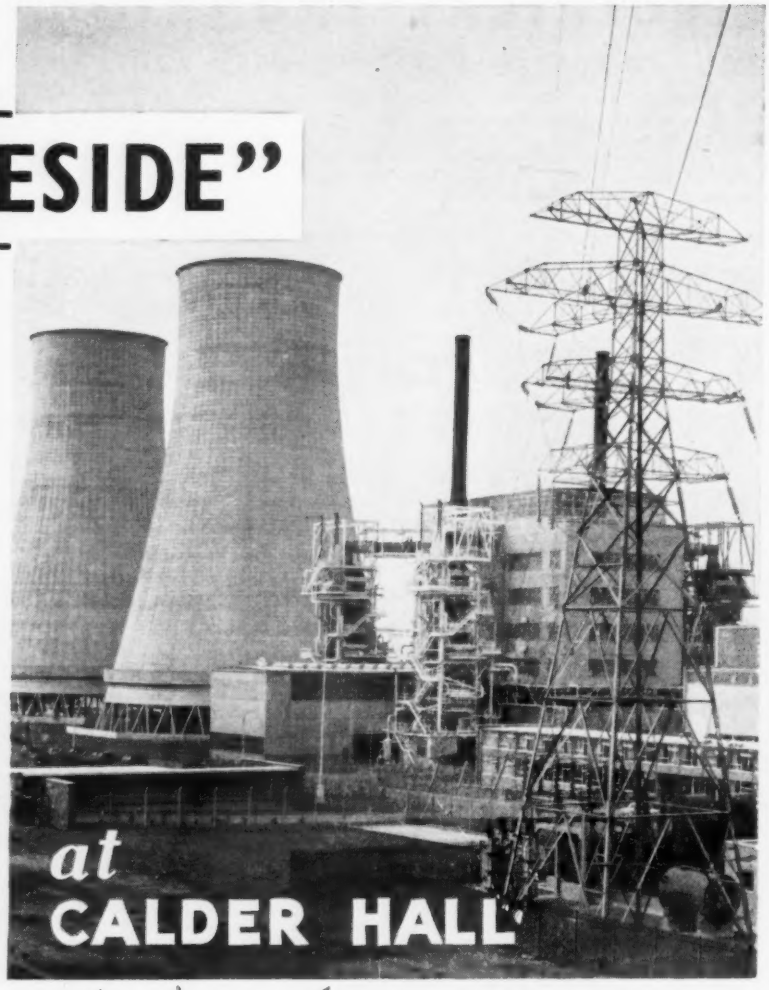

Photo by courtesy U.K. Atomic Energy Authority

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Control Gear Glossary

FOUR-LANGUAGE GUIDE TO USERS OF CONTINENTAL EQUIPMENT

DATA SHEET 36

DURING the last few years there has been an increasing import of engineering equipment from the Continent, some of it electrical equipment in its own right and some of it general mechanical plant incorporating its own electrical drives or control gear. With the creation of the two major economic groups (European Common Market and European Free Trade Area), the tendency is likely to grow. Although a large part of this equipment will be provided with English-language instruction manuals and the like, there will probably be an increasing number of occasions when the works engineer will be faced with foreign-language terms inscribed on the equipment. It is to meet such occasions that the following glossary has been prepared. It gives only the more common terms and for this reason does not purport to be exclusive. Certain terms (such as motor) have been omitted because of their similarity in all four languages.

Name-plate details, general terms

English	French	German	Italian	Swedish
speed, r.p.m.	Vitesse, rev/m	Drehzahl, U/min	Velocità di rotazione, giri al minuto	Hastighet, v/min
voltage, volts	Tension	Spannung, V	Tensione, voltaggio	Spänning, volt
current	Intensité	Stromstärke	Corrente (Intensità)	Ström
a.c.	courant alternatif (c.a.)	Wechselstrom (WS) Drehstrom (DS)	Corrente Alternata (c.a)	Växelström (VS)
d.c.	courant continu (c.c.)	Gleichstrom (GS)	Corrente continua (c.c.)	Kontinuerligström (KS)
rating	Régime nominal	Nennleistung	Prestazione (di esercizio)	Klass
load, h.p.	charge, cv	Aufnahme, PS	Carico, CV	Last, h.k.
frequency, c/s	fréquence, Hz (Hertz)	Frequenz, Hz	Frequenza, Hz	Freqvens, p/s
power factor	facteur de puissance	Leistungsfaktor	Fattore di potenza	Effekt faktor
star	étoile	Stern	stella	Stjärn
delta	delta (triangle)	Dreieck	triangolo	Triangel
inductance	inductance	Induktivität	Induttanza	Induktans
capacitance	capacité	Kapazität	Capacità	Kapacitans
resistance	résistance	Widerstand	Resistenza	Motstånd
reactance	réactance	Blindwiderstand	Reattanza	Reaktans
calibration	étalonnage	Eichung	Taratura (Calibratura)	Kalibrering
setting	réglage	Einstellung	Messa a punto, registrazione	Sättning
no load (idle)	à vide (repos)	Nullast (Leerlauf)	Senza carico (a vuoto)	Utan belastning (fri)
full load	pleine charge	Vollast	Carico pieno	Full belastning
safe load	charge de sécurité	Normallast	carico di sicurezza	Överbelastning
overload	surcharge	Ueberlastung	sovraccarico	Säkerbelastning
continuous rating	régime permanent	Dauerleistung	prestazioni di esercizio per servizio continuato	Fortlöpande klass
intermittent rating	régime discontinu	vorübergehende Leistung	prestazioni di esercizio per servizio intermittente	Avbrytad klass
torque	couple	Drehmoment	Coppia	Vridkraft
stalling torque	couple mixiмum	kritisches Drehmoment	Coppia di ferma	Stannvridkraft
short-circuit	court-circuit	Kurzschluss	corto circuito	Kortslutning
starting	démarrage	Anlauf	avviamento	Igångsättning
running	marche	Lauf, Betrieb	in marcia	Löpning
connections	connexions	Verbindungen	collegamenti, connessioni	Förbindelse
supply (mains)	alimentation (secteur)	Netz	reti di distribuzione, linee principali	Strömleverans (strömnät)
line (phase)	ligne (phase)	Leitung, Leiter (phase)	linea (fase)	Ledning (fas)
neutral (star point)	neutre	Nulleiter (Nullpunkt)	punto neutro	Noll (stjärn punkt)
earth	masse, terre	Erde, Masse	terra (mettera a terra, masse)	Jord
efficiency	efficacité	Wirkungsgrad	rendimento (efficienza)	Verkningsgrad
losses	pertes	Verluste	perdite	Förluster
output	puissance	Leistung, Ausgang	potenza sviluppata	Tillverkning
operating duty (starts/hr)	charge normale (démarrages/heure)	Bedienungsaufgabe, (Anlässe/st)	caratteristiche d'impegio, (numero d'avviamenti all'ora)	Verkplikt (start/timma)
gear ratio	rapport de denture	Getriebe-(Uebersetzungs-) Verhältnis	rapporto degli ingranaggi	Utväxling

Equipment and Components

contactor	contacteur	Einschalter, Automat	contatore	Kontaktor
starter	démarreur	Anlasser	avviatore	Startare
isolator	isolateur	Isolator	sezionatore	Franskiljare
switch	interrupteur	Schalter	interruttore	Strömbrytare
fuses	coupe-circuits	Sicherungen	fusibili	Säkringen
contacts	contacts	Kontakte	contatti	Kontakte
main contacts	contacts principaux	Hauptkontakte	contatti principali	Huvudkontakte
auxiliary contacts	contacts secondaires	Hilfskontakte	contatti ausiliari	Hjälpkontakte
spring	ressort	Feder	molla	Fjäder
choke (coil)	bobine (d'arrêt)	Drossel (-Spule)	bobine d'arresto	Stopspole (spole)
capacitor	condensateur	Kondensator	condensatore	Kondensator
terminals	bornes	Klemmen	morsetti (terminale)	Poler
relay	relais	relais	relè	relä

English	French	German	Italian	Swedish
interlock	couplage	Verriegelung	collegamento con azione combinata	Förregling
time delay	commande à action différée	Verzögerung(s-), Zeit-	dispositivo ad azione ritarda	Fördröjning
thermal delay	dispositif thermique à action différée	Wärmeverzögerung	dispositivo ad azione ritarda termica	Värmefördröjning
pneumatic delay	dispositif pneumatique à action différée	Druckluftverzögerung	dispositivo ad azione ritarda pneumatica	Pneumatisk fördröjning
hydraulic delay	dispositif hydraulique à action différée	Hydraulikverzögerung	dispositivo ad azione ritarda idraulica	Hydraulisk fördröjning
dash pot	dahspot	Stossdämpfer	smorzatore	Stötfångare
overload trip	déclenchement de surcharge	Ueberlastungs-Auslösung	scatto di sovraccarico	Överbelastnings lösgivare
safety trip	déclenchement de sécurité	Sicherheits-Auslösung	scatto di sicurezza	Säkerhets lösgivare
trip bar	déclencheur	Auslöseklinke	barra di commando di scatto	Lösgivarestång
cam	came	Daumenscheibe	camma (eccentrico)	Nock
rotor	rotor	Läufer	indotto (routa)	Rotor
stator	stator	Stator	statore	Stator
armature	induit	Anker	rotore (armatura)	Ankere
field (excitation)	champ (excitation)	Feld (Erregung)	campo (eccitazione)	Fält (magnetisering)
poles	poles	Pole, Polschuhe	poli	Pol
winding	enroulment	Wicklung	avvolgimento	Spolning
commutator	collecteur	Kommutator, Kollektor	collettore (a lamelle)	Kommuator
slip ring	bague collectrice	Schleifring	anello	Släp ring
brush	balais	Bürste	spazzola	Borste
brushgear	porte-balais	Bürstenhalterung	portaspazzole	Borste mekanism
laminations (stampings)	tôles de circuit magnétique	Lamellen (Stanzbleche)	lamierini	Pläteringen (pressningar)
electromagnet	électro-aimant	Elecktromagnet	elettromagnete	Elektromagnet
wire (lead)	fil (conducteur)	Leitung	conduttore	Tråd (ledning)
bare wire	fil nu	blanker Draht	filo nudo	Blanktråd
insulated (covered) wire	fil isolé (fil guipé)	isolierter (überzogener) Draht	conduttore isolatore	Isolierad (omspunnad) tråd
rheostat	rhéostat	Rheostat, elektrisches Widerstand	reostato	Reostat
regulator	régulateur	Regler	regolatore	Regulator
controller	contrôleur	Steurgerät	combinatore	Kontrollör
plug	fiche	Stecker	spina	Stickkontakt
socket	douille, prise	Steckdose	presa (di corrente)	Väggkontakt
coupler	connecteur	Verbindung	accoppiatore	Koppling
coupling	couplage	Kuppelung	accoppiamento	Koppling
moulding	moulage, moulure	Pressteil	getto	Gjutning
brake	frein	Bremse	freno	Broms
pushbutton	bouton poussoir	Druckknopf	pulsante	Tryckknop
remote pushbutton	bouton poussoir de télécommande	fernsteuernder Druckknopf	telecommando	Fjärran tryckknop
adjusting screw	vis de réglage	Stellschraube	vite di regolazione	Regelskruv
adjusting knob	bouton de réglage	Einstellknopf	manopola di regolazione	Regelknop
lubrication	graissage	Schmierung	lubrificazione	Smörjning
oil	huile	Oel, Schmieröl	olio	Olja

Control Operations

on	en circuit	ein	inserito	På
off	hors circuit	Aus	disinserito	Av
start	démarrage	Anlassen	avviamento	Start
stop	arrêt	Abstellen	fermo	Stop
run	marche	Betrieb, An	marcia	Löpa
reset	réenclenchement	Zurückstellen	risistemare	Återställa
hand (manual)	main (manuel)	Hand (von Hand betätigt)	a mano	Hand (manuell)
in	engagé	ein, hinein	dentro	In
out	dégagé	aus, heraus	fuori	Ut
up	levé	auf, hinauf	su	Upp
down	baissé	ab, hinab, hinunter	giù	Ned
forward	avant	vor, Vorlauf	avanti	Förväg
reverse	arrière	zurück, Rückgang	indietro	Omvänd
fast	rapide	schnell, Schnellgang	veloce	Hastig
slow	lent	langsam	lento, piano	Långsam
hoist (raise)	lever (monter)	heben	issare, sollevare	Hissa (upphissa)
lower	abaisser	senken	calare	Sänka
inch	régler par étapes successives	Kriechgang	spostare (ruotare, avanzare) a gradi	Krypa
crawl	accrocher	langsamer Lauf	impuntare	Kräla
feed	alimenter	Zufuhr, Vorschub	alimentare	Marning
luff	relever	Luv (seite)	alzare (abbassare) il braccio	Vippa
slew	orienter	Schwenken	girare	Svänga
traverse	déplacer latéralement	Querverschieben	spostarsi lateralmente	Overgå
travel	déplacer	Bewegen, Fahren	percorrere	Rörelse
accelerate	accélérer	Beschleunigen	accelerare	Påskynda
decelerate	ralentir	Verlangsamen	decelerare	Minska hastighet
high	élevé	hoch, Hoch-	alto	Hög
low	bas	niedrig, tief, Tief-	basso	Låg

Arc furnaces for largest electric steel plant

ELECTRIC arc furnaces for the recently announced £10 million electric steel-making plant of the United Steel Companies Ltd. will each have a rating of 40 MVA. The first are to be manufactured by GWB Furnaces Ltd., and they will be of Demag design, although apart from the regulator they will be entirely of British manufacture. When the United Steel Co. scheme is completed in five years' time, the Dudley, Worcestershire, branch of Steel, Peech and Tozer will have six of these furnaces which will replace 21 open-hearth furnaces. The installation will rate as the largest electric steel-making plant in the world, with an output of 1,350,000 ingot tons of steel a year. The first furnace is to begin operation in 1963.

Furnace Details

Each furnace shell will have an internal diameter of 24 ft, a nominal capacity of 150 tons, and will be capable of melting at the rate of one ton/minute. In practice, the furnaces will be used for a minimum of 110 tons ingot weight. Construction of the furnaces will follow the well-known "Demag" king pin or gantry design, in which the roof is the only item lifted from the shell when the top charging takes place (Fig. 1). The weight of the electrode equipment is permanently carried by the gantry, which after raising the roof swings aside for furnace charging around the king post. Roof raising is by hydraulic cylinder and the gantry is swung aside by an a.c. motor and gear train. Shell and gantry are mounted on a platform which is supported by three arc-shaped rockers, which allow the furnace to tilt forward 45° for pouring and 15° backwards for slagging. The drive for tilting will be by means of d.c. motors through a gear train to pendant pin racks attached to the underside of the furnace.

To facilitate the initial melt, shell rotation is incorporated and will allow the drilling of the scrap in three positions of each electrode. Rotation is 40° either side the normal electrode position, and this rotation is provided by means of an a.c. motor and gear train.

Electrical Design

One of the serious shortcomings of the modern high-powered arc furnace is the uneven lining wear due to a hot spot which appears around the centre electrode and to a lesser extent one of the other two electrodes will also have a minor hot spot. This undesirable state of affairs is caused by the shorter length of busbar work to the centre phase and by the unequal mutual inductance between the phases causing the arc voltages to be unequal. These furnaces will embody a patented feature of De Roll (Switzerland) whereby the delta will be closed on the electrodes, so that all busbar work from the transformers is compensated by the full interleaving of the flow and return bars.

While GWB are in a position to offer hydraulic or static magnetic amplifier or rotating regulators for controlling the electrodes, an hydraulic system has been chosen in this instance because of its high speed of response. The regulator is a true impedance type; in principle is not unlike the ordinary moving-coil loudspeaker. An aluminium former carrying the current and potential windings relative to the arc condition operates in a strong magnetic field provided by a d.c. magnet, and moves in accordance with the variations in the values of the current and potential components. A servo oil-control valve is connected to this former so that movement of the latter controls the flow of oil to the hydraulic valve regulating the electrode position. The windings being air-cored have a high rate of response and the sensitivity is of a very high order.

Power for the arcs will be provided by a three-phase transformer which will follow modern design tendencies. On-load tap changing will be provided in a regulating transformer which feeds into a fixed ratio stepdown transformer. Both transformers are contained in the same tank and are forced-oil-cooled through external water-cooled heat exchangers. Two coolers, each capable of dealing with the full-load losses of the transformer, are provided. The incoming supply will be 33 kV three-phase, 50 c/s and the maximum arc voltage will be 565 volts.

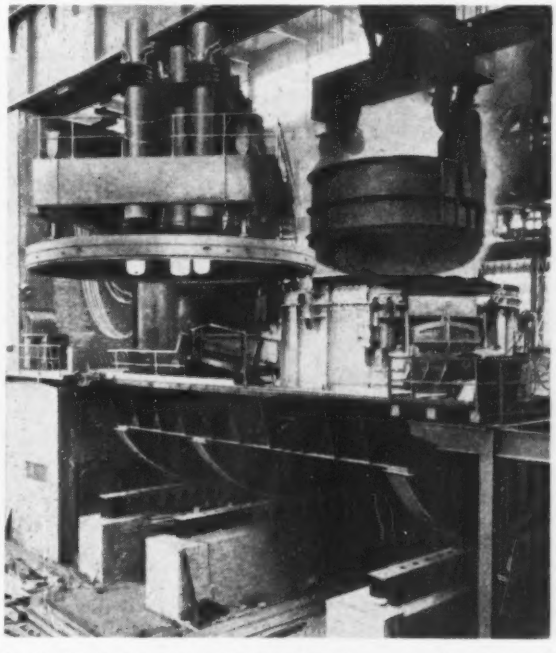

Fig. 1. Roof of furnace, including electrodes, swung clear to permit top charging. The roof is permanently carried on a gantry

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interlock	couplage	Verriegelung	collegamento con azione combinata	Förregling
time delay	commande à action différée	Verzögerung(s-), Zeit-	dispositivo ad azione ritarda	Fördröjning
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stator	stator	Stator	statore	Stator
armature	induit	Anker	rotore (armatura)	Ankere
field (excitation)	champ (excitation)	Feld (Erregung)	campo (eccitazione)	Fält (magnetisering)
poles	poles	Pole, Polschuhe	poli	Pol
winding	enroulment	Wicklung	avvolgimento	Spolning
commutator	collecteur	Kommutator, Kollektor	collettore (a lamelle)	Kommuator
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brush	balais	Bürste	spazzola	Borste
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regulator	régulateur	Regler	regolatore	Regulator
controller	contrôleur	Steurgerät	combinatore	Kontrollör
plug	fiche	Stecker	spina	Stickkontakt
socket	douille, prise	Steckdose	presa (di corrente)	Väggkontakt
coupler	connecteur	Verbindung	accoppiatore	Koppling
coupling	couplage	Kuppelung	accoppiamento	Koppling
moulding	moulage, moulure	Pressteil	getto	Gjutning
brake	frein	Bremse	freno	Broms
pushbutton	bouton poussoir	Druckknopf	pulsante	Tryckknop
remote pushbutton	bouton poussoir de télécommande	fernsteuernder Druckknopf	telecommando	Fjärran tryckknop
adjusting screw	vis de réglage	Stellschraube	vite di regolazione	Regelskruv
adjusting knob	bouton de réglage	Einstellknopf	manopola di regolazione	Regelknop
lubrication	graissage	Schmierung	lubrificazione	Smörjning
oil	huile	Oel, Schmieröl	olio	Olia

Control Operations

on	en circuit	ein	inserito	På
off	hors circuit	Aus	disinserito	Av
start	démarrage	Anlassen	avviamento	Start
stop	arrêt	Abstellen	fermo	Stop
run	marche	Betrieb, An	marcia	Löpa
reset	réenclenchement	Zurückstellen	risistemare	Återställa
hand (manual)	main (manuel)	Hand (von Hand betätigt)	a mano	Hand (manuell)
in	engagé	ein, hinein	dentro	In
out	dégagé	aus, heraus	fuori	Ut
up	levé	auf, hinauf	su	Upp
down	baissé	ab, hinab, hinunter	giù	Ned
forward	avant	vor, Vorlauf	avanti	Förväg
reverse	arrière	zurück, Rückgang	indietro	Omvänd
fast	rapide	schnell, Schnellgang	veloce	Hastig
slow	lent	langsam	lento, piano	Långsam
hoist (raise)	lever (monter)	heben	issare, sollevare	Hissa (upphissa)
lower	abaisser	senken	calare	Sänka
inch	régler par étapes successives	Kriechgang	spostare (ruotare, avanzare) a gradi	Krypa
crawl	accrocher	langsamer Lauf	impuntare	Kräla
feed	alimenter	Zufuhr, Vorschub	alimentare	Marning
luff	relever	Luv (seite)	alzare (abbassare) il braccio	Vippa
slew	orienter	Schwenken	girare	Svänga
traverse	déplacer latéralement	Querverschieben	spostarsi lateralmente	Overgå
travel	déplacer	Bewegen, Fahren	percorrere	Rörelse
accelerate	accélérer	Beschleunigen	accelerare	Påskynda
decelerate	ralentir	Verlangsamen	decelerare	Minska hastighet
high	élevé	hoch, Hoch-	alto	Hög
low	bas	niedrig, tief, Tief-	basso	Låg

Arc furnaces for largest electric steel plant

ELECTRIC arc furnaces for the recently announced £10 million electric steel-making plant of the United Steel Companies Ltd. will each have a rating of 40 MVA. The first are to be manufactured by GWB Furnaces Ltd., and they will be of Demag design, although apart from the regulator they will be entirely of British manufacture. When the United Steel Co. scheme is completed in five years' time, the Dudley, Worcestershire, branch of Steel, Peech and Tozer will have six of these furnaces which will replace 21 open-hearth furnaces. The installation will rate as the largest electric steel-making plant in the world, with an output of 1,350,000 ingot tons of steel a year. The first furnace is to begin operation in 1963.

Furnace Details

Each furnace shell will have an internal diameter of 24 ft, a nominal capacity of 150 tons, and will be capable of melting at the rate of one ton/minute. In practice, the furnaces will be used for a minimum of 110 tons ingot weight. Construction of the furnaces will follow the well-known "Demag" king pin or gantry design, in which the roof is the only item lifted from the shell when the top charging takes place (Fig. 1). The weight of the electrode equipment is permanently carried by the gantry, which after raising the roof swings aside for furnace charging around the king post. Roof raising is by hydraulic cylinder and the gantry is swung aside by an a.c. motor and gear train. Shell and gantry are mounted on a platform which is supported by three arc-shaped rockers, which allow the furnace to tilt forward 45° for pouring and 15° backwards for slagging. The drive for tilting will be by means of d.c. motors through a gear train to pendant pin racks attached to the underside of the furnace.

To facilitate the initial melt, shell rotation is incorporated and will allow the drilling of the scrap in three positions of each electrode. Rotation is 40° either side the normal electrode position, and this rotation is provided by means of an a.c. motor and gear train.

Electrical Design

One of the serious shortcomings of the modern high-powered arc furnace is the uneven lining wear due to a hot spot which appears around the centre electrode and to a lesser extent one of the other two electrodes will also have a minor hot spot. This undesirable state of affairs is caused by the shorter length of busbar work to the centre phase and by the unequal mutual inductance between the phases causing the arc voltages to be unequal. These furnaces will embody a patented feature of De Roll (Switzerland) whereby the delta will be closed on the electrodes, so that all busbar work from the transformers is compensated by the full interleaving of the flow and return bars.

While GWB are in a position to offer hydraulic or static magnetic amplifier or rotating regulators for controlling the electrodes, an hydraulic system has been chosen in this instance because of its high speed of response. The regulator is a true impedance type; in principle is not unlike the ordinary moving-coil loudspeaker. An aluminium former carrying the current and potential windings relative to the arc condition operates in a strong magnetic field provided by a d.c. magnet, and moves in accordance with the variations in the values of the current and potential components. A servo oil-control valve is connected to this former so that movement of the latter controls the flow of oil to the hydraulic valve regulating the electrode position. The windings being air-cored have a high rate of response and the sensitivity is of a very high order.

Power for the arcs will be provided by a three-phase transformer which will follow modern design tendencies. On-load tap changing will be provided in a regulating transformer which feeds into a fixed ratio stepdown transformer. Both transformers are contained in the same tank and are forced-oil-cooled through external water-cooled heat exchangers. Two coolers, each capable of dealing with the full-load losses of the transformer, are provided. The incoming supply will be 33 kV three-phase, 50 c/s and the maximum arc voltage will be 565 volts.

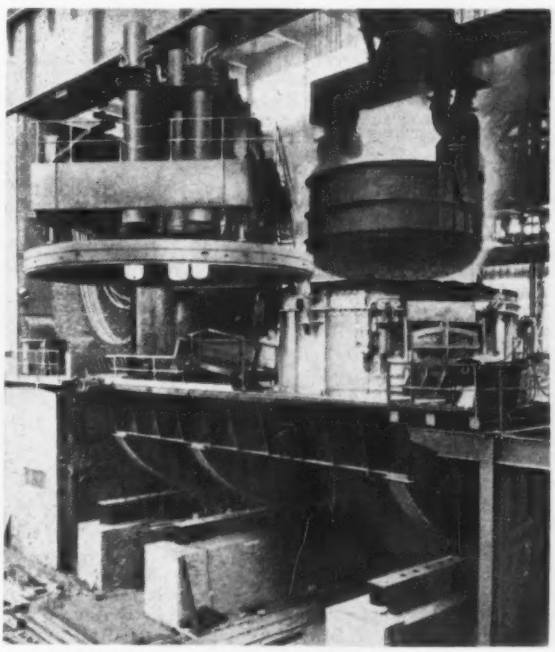


Fig. 1. Roof of furnace, including electrodes, swung clear to permit top charging. The roof is permanently carried on a gantry

OVERSEAS NEWS

from our correspondents abroad

CANADA

Looking Ahead

The question of providing additional power capacity for the southern interior region of British Columbia is now under active consideration by the provincial Power Commission. It is estimated that further sources will be required by 1965. The Clearwater River system, north of Kamloops, which has over 1 million h.p. available through stage-by-stage development, is likely to be lowest in cost. The Commission is also studying possibilities of the Homathko, Kokish and Ucona River systems for future potential for Vancouver Island. Forecasts have indicated that the 51,500 h.p. potential of the Kokish River at the north end of Vancouver Island will be needed in late 1964. Unless other sources of supply materialise this project will likely be part of the provincial Government's recently announced North Vancouver Island development policy.

Rural Subsidy

Financial assistance is to be provided by the British Columbia Government in extending electricity service to rural areas by the BC Power Commission. It is anticipated that the subsidy will permit the connection of 3,000 remote consumers over a three-year period. Capital costs of the three years' work are expected to reach $4,000,000. The subsidy to meet operational losses will be an annual cost to the provincial Government not exceeding $200,000. The plan is expected to take electrical service to between 80 and 90 communities which do not now enjoy such service. Financial assistance will be provided where the capital cost of extending service is more than $800 per customer. A ceiling of $1,600 per customer is set on capital costs, but this may be exceeded if the customer agrees to meet the costs over $1,600.

BRITISH GUIANA

Supply Investigation

Supply officials in Georgetown, British Guiana, are now awaiting the publication of the report of the Public Commission which has recently been investigating the severe breakdown of the plant of the Demerara Electric Co. That breakdown, which started last September, giving Georgetown its worst blackout since the war, has continued to affect a number of areas for many months. The breakdown, due to a mishap to a large boiler, put two-thirds of the company's generating plant out of action. At one period the city banks were being given a supply from midnight to 6 a.m. to enable them to keep their books in order, but the breweries were not getting enough power to enable them to brew! The aid of Mr H. G. Frampton, M.I.E.E., formerly deputy chief safety officer to the CEA, has been invoked, and he is now acting as Controller of Electricity, his duties being concerned with the rationing of available electricity supplies. Meantime the Government have acted by obtaining two small mobile generating sets from the USA, as we reported on 10 Dec. There are some in Georgetown, who consider that the Demerara Electric Co. have not adequately fulfilled their obligations, and it is suggested that the undertaking should be taken over. Some negotiations have already been commenced in this direction, but in any event plans must soon be made to provide for normal expansion of the undertaking's generating capacity.

BRAZIL

Plant Wanted

A new generating station with three 33 MW sets is to be built on the Tiete River, near Bariri, for the Companhia Hidroelectrica do Rio Pardo, which is controlled by the State of Sao Paulo, Brazil. Approaches are now being made to firms for the supply of the necessary equipment.

ARGENTINA

Nuclear Survey

After the results of the general power survey for Argentina now being made by the International Bank have been evaluated, the question of possible nuclear power is to be considered. The International Atomic Energy Agency is soon to send a mission to Argentina to carry out this survey of nuclear power needs.

U.S.A.

Protest at Low Bid

Official protest has been lodged by the English Electric Co. with the US Bureau of Reclamation, concerning the low tender of the Baldwin-Lima-Hamilton Corporation for the supply of eight hydraulic turbines for the Glen Canyon Dam, Arizona. English Electric submitted the lowest tender (of $6,214,550), with Baldwin-Lima-Hamilton second (at $6,392,000). The latter might claim the 6% differential allowed to American producers under the Buy American Act, but English Electric allege that under the Baldwin-Lima-Hamilton proposal / over 50% of the work on the turbines would be carried out by the Belgian associate company, Societe Anonyme Cockerill-Ougree Seraing. But Baldwin-Lima maintain that the latter company would provide only 42·7% of the work, just sufficient to come inside the 50% limit allowed.

NIGERIA

UN Investigation

The United Nations Organisation has announced that it plans to spend $1 million to study the feasibility of a multi-purpose dam on the Niger River, in Western Nigeria. The Electricity Corporation of Nigeria has already carried out several surveys.

POLAND

Copper Wire

The first section of equipment under a £2¼ million railway electrification contract was recently dispatched to Poland by British Insulated Callender's Construction Co. Ltd., one of the three British firms concerned. The first consignment consisted of 83 drums of 100 sq mm grooved copper trolley wire, 29 drums of 107 sq mm similar wire, and 15 drums of 19 strand hard-drawn bare cadmium copper wire. A second consignment of 200 metric tons of 100 sq mm wire was shipped a few days later. This is part of a contract, announced last July, under which BICC, English Electric and Metropolitan-Vickers Electrical Co. were to supply o.h. line equipment and 20 electric locomotives, in addition to granting a licence for the manufacture of similar locos in Poland.

EGYPT

More Russian Aid

Russia is to undertake work for the second stage of the Aswan High dam scheme (which includes the power

station), it was revealed on Monday. The news has not come as a surprise in many quarters, for it was evident that the revised plan put forward by the Russian engineers virtually comprised a merging of stages I and II, apart from the question of financing. No figure has yet been given of the amount of Russian credit being granted to Egypt under the latest agreement.

INDIA

Production Speed-up

Broad agreement on the proposed speed-up of the second and third stages of construction of the heavy electricals factory at Bhopal was reached by Lord Chandos, chairman of AEI, and Mr M. M. Shah, Indian Minister of State for Industry, during the former's present visit to India. We reported last week that the Government had decided to expedite the later stages of the scheme. Mr Shah last week stated that half of India's estimated requirements of heavy electrical equipment by the end of the third Five-Year Plan would be met by the Bhopal plant. He added that in addition to this project, similar plants were proposed for India with Russian and Czechoslovak co-operation.

NEW ZEALAND

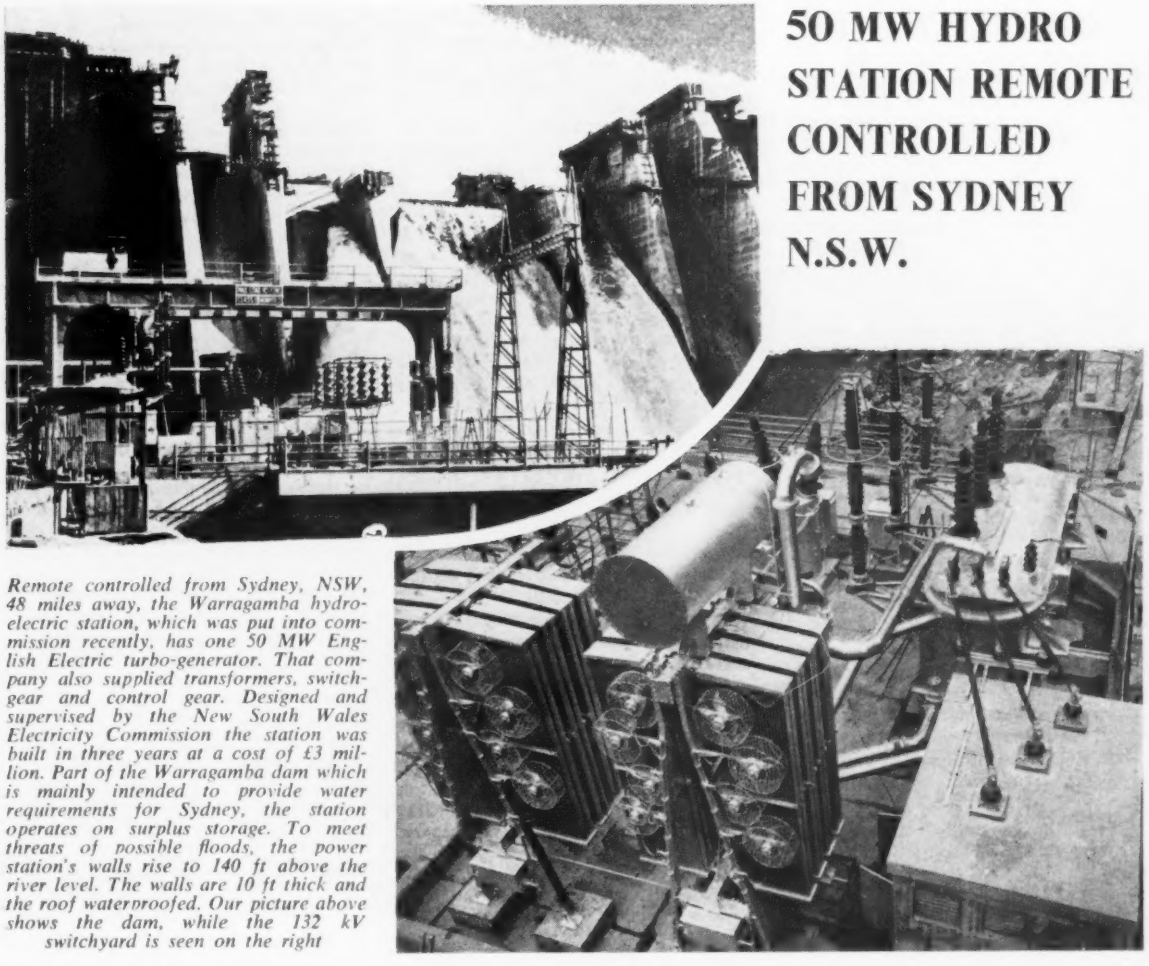
Aluminium Scheme

Signing of the agreement on the first exploratory stage of a new aluminium smelting industry in South Island, took place at Wellington earlier this week. Senior directors of Consolidated Zinc of Australia signed the agreement, along with the Premier of New Zealand. The project involves the construction of a hydro-electric plant, and the agreement provides for a detailed engineering survey to be taken of the Te Anau Manapouri lakes system. As part of the scheme the Consolidated Zinc Co. had earlier considered the possibility of power development in Australia or New Guinea, but they have apparently now decided that sites there could not offer low cost power and suitable scope for development. The company is to mine the huge bauxite deposits in Queensland, but because Australian regulations prohibit the shipment of raw bauxite out of that country, it is to be developed on the spot to first-stage alumina. The latter would then be shipped to New Zealand for smelting. Officials in New Zealand have estimated that the cost of power from Lake Manapouri would be not more than 0·2d per unit, compared with about 0·8d for a coal-fired station or 0·5d for an alternative hydro-electric scheme. The present plan would involve raising the level of Lake Manapouri 100 ft and joining it with Lake Te Anau, which is now 80 ft above Manapouri and separated from it by a narrow strip of land. Engineers claim that the scheme would not spoil Manapouri, which is regarded as one of New Zealand's most beautiful lakes.

New North Island Station

Tenders are soon to be called for the supply of two 35 MW turbo-generators, plus associated plant, for the new Matahina power station which is to be built on the Rangitaiki River for the New Zealand Electricity Department. This station intended to supply power in North Island by 1965, was approved by the Government last September, when it was decided that from technical data prepared, it was preferable to the alternate Kaituna scheme.

50 MW HYDRO STATION REMOTE CONTROLLED FROM SYDNEY N.S.W.



Remote controlled from Sydney, NSW, 48 miles away, the Warragamba hydro-electric station, which was put into commission recently, has one 50 MW English Electric turbo-generator. That company also supplied transformers, switchgear and control gear. Designed and supervised by the New South Wales Electricity Commission the station was built in three years at a cost of £3 million. Part of the Warragamba dam which is mainly intended to provide water requirements for Sydney, the station operates on surplus storage. To meet threats of possible floods, the power station's walls rise to 140 ft above the river level. The walls are 10 ft thick and the roof waterproofed. Our picture above shows the dam, while the 132 kV switchyard is seen on the right

Personalities *in the industry*

Mr W. Lionel Fraser

Sir Kenneth Hague

Mr F. H. Shrimpton

Mr E. W. Batho

Mr C. A. P. Cannon

Chairman of Babcock and Wilcox Ltd. for nearly ten years, **Mr W. Lionel Fraser,** C.M.G., is to retire from the board after the company's annual general meeting on 26 May, as he earlier intimated. **Sir Kenneth Hague,** M.I.MECH.E., M.I.E.E., now deputy chairman, will take over the chairmanship and **Sir Reginald Verdon Smith,** J.P., B.C.L., M.A., is to become deputy chairman. In acknowledgment of Mr Fraser's services it is proposed to create the position of president of the company and to invite him to accept the appointment. Before joining Babcock's, Mr Fraser was a joint deputy chairman of Tube Investments Ltd. He remains chairman of other concerns. Sir Kenneth Hague joined Babcock and Wilcox in 1923 as a combustion and operating engineer. He became chief of the Project Dept. in 1928 and technical liaison officer with the US company in New York in 1930. Returning to this country he subsequently held the posts of general sales manager; director and general sales manager; deputy managing director; managing director in 1945, and deputy chairman and managing director in 1950. He is currently president of the Engineering and Allied Employers' National Federation, an office he relinquishes at the end of February. He has also served on many other bodies, including the Engineering Advisory Council, and the Grand Council of the FBI.

Lord Plowden has been appointed chairman of British Aluminium Co. **Sir Ivan Stedeford** has resigned his directorship and been appointed alternate director to Lord Plowden.

Mr G. L. Knight has been appointed assistant to the director of the Scientific Instrument Manufacturers' Association.

Mr J. E. C. Bailey, C.B.E., M.I.EX., chairman and managing director of Baird and Tatlock (London) Ltd. and Hopkin and Williams Ltd., will leave the UK by air on 30 Jan. in order to visit the companies' branches, agents, representatives and customers throughout East, Central and South Africa.

Mr F. H. Shrimpton, M.I.S.M.A., has been appointed home service manager to AEI-Hotpoint Ltd. He joined BTH as an apprentice in 1927, and from 1934 was concerned with f.h.p. motor sales and special contract work. Between 1947 and 1949 he was Hotpoint's district office manager at Birmingham, and until 1953 was factory superintendent at Premier Wks, Birmingham, of which he became manager. He was appointed Southern Division sales manager in 1956 and in December of the following year became marketing manager, small appliances.

Mr William McKay, director and chief engineer has been appointed managing director of La Mont Steam Generator, succeeding **Mr A. E. L'Herminier,** who is continuing as chairman.

Mr A. Cusins has been appointed manager of the London office of Belliss and Morcom Ltd., as from 1 Feb.

Mr H. Hardman, M.P.O.A., has been appointed assistant secretary (purchasing, contracts and stores) in the regional secretary's department of the Southern South Western and South Wales Region of the CEGB (*ESH page 55). Since 1948 he has been purchasing officer to the South Western Division, and earlier, was with the CEB staff in Bristol.

Secretary of the North Western Electricity Board since February, 1948, **Mr J. W. Chant,** M.L.S., F.C.C.S., is retiring from the service of the board (*ESH, page 147). Mr Chant, who is aged 53, served with the Yorkshire Electric Power Co. from 1937 until nationalisation of the industry, initially as legal assistant. He became assistant secretary in 1938, and, on the retirement of Mr J. J. H. Stansfield in 1939, became secretary of that company and, with the exception of Electricity Hse Ltd., of its associated companies. Articled in London, he was admitted a solicitor in 1927, and was managing clerk with a firm of solicitors in Leicester until 1930, when he was appointed assistant solicitor on the staff of the town clerk of Sheffield.

London manager of Erskine Heap and Co. Ltd., **Mr E. Jackson,** A.M.I.E.E., has retired after 40 years' service in that position. He still remains a director. His successor as London manager is **Mr E. W. Batho,** A.M.I.E.E., who has been Mr Jackson's deputy since the end of the war. Mr Batho served his apprenticeship at the BTH Willesden switchgear works, receiving technical training at the Regent St Polytechnic. He subsequently spent two years with English Electric Co. Ltd. at Stafford in switchgear engineering, and a year with Johnson and Phillips Ltd. on cable research, before joining Erskine Heap in 1935.

Production manager of Measuring Instruments (Pullin) Ltd. since 1953, **Mr C. A. P. Cannon** has now been appointed assistant to the managing director, **Mr J. P. Steward.** During the 20 years he has been with the firm, Mr Cannon has acquired practical experience of the workings of most of its sections, including the instrument testing department, the drawing office, planning and scheduling and the development department. From time to time he has supplemented this by attending specialist courses in instrumentation. In addition to his new duties, Mr Cannon will continue to act as production manager of MIP's works at Acton.

Mr J. C. Moston, director and joint general manager of Connollys Ltd., has been elected chairman of the Cable Makers' Association. Other new chairmen are **Mr C. H. Broughton Pipkin,** A.M.I.MECH.E., M.I.E.E., manager (home sales) British Insulated Callenders' Cables Ltd., for the Mains Cable Manufacturers' Association (Super Tension).

** Denotes revision to the "Electricity Supply Handbook, 1959."*

and **Mr A. Clitherow** for the Rubber and Thermoplastic Cable Export Group.

Mr W. H. Smith is to retire from chairmanship and from the board of Allied Ironfounders Ltd. on 31 March. Mr Smith has been over 60 years in the industry and was one of the original members of the board when the present holding company was formed in 1929. The new chairman will be **Mr G. S. Steven,** now vice-chairman and joint managing director, who will continue as joint managing director with **Mr H. C. Wilson Bennetts.**

The honorary degree of Doctor of Science of Liverpool University is to be conferred on **Prof N. F. Mott,** F.R.S., Cavendish Professor of Experimental Physics on 30 April.

Mr R. H. Hensman, F.C.I.S., deputy secretary of Cable and Wireless Ltd., has been appointed secretary with effect from 1 Feb., in succession to **Mr F. H. Lansbury,** O.B.E., F.C.I.S., who, having passed the age of retirement, will relinquish the position at the end of this month after 39 years' service. **Mr H. A. Cox,** M.B.E., A.C.I.S., assistant secretary, has been promoted to deputy secretary, and **Mr A. A. Willett,** A.C.I.S., of the secretary's office, to assistant secretary in place of Mr Cox.

Due to increased activities in other directions, **Mr W. Corfield** has relinquish his Lancashire and Cheshire agency with Radiovisor Parent Ltd. The company is in the process of opening its own northern office under the direction of **Mr A. C. Stewart,** A.M.I.E.E., who will be assisted by **Mr D. A. Dawson.** This office will be responsible for all sales in the north of England.

The EAW Diploma in Electrical Housecraft has been awarded to **Mrs E. G. Johnson,** Midlands Electricity Board, Worcester, and to **Miss H. Reeves,** South Eastern Electricity Board, Oxted.

AEI (Rugby) Ltd., formerly the British Thomson Houston Co. Ltd., announce the appointment of **Mr D. Edmundson,** B.SC., M.I.E.E., as general manager, Rugby Works. This will enable **Mr H. E. Cox,** who has been general manager since 1957, to devote his time to the duties of deputy director of manufacture. Mr Edmundson, a native of Gateshead-on-Tyne, was educated at Saffron Walden and Rugby College of Technology and Arts (now Rugby College of Engineering Technology) and served an engineering apprenticeship with BTH. In 1934, he became a design engineer in A.C. Engineering Department, Rugby, and liaison engineer with Motor Department, Rugby, and liaison engineer with Motor Department, Trafford Park, Manchester. In 1940 he was appointed head of the electrical laboratory, and in 1946 test engineer, Rugby Works, eventually becoming superintendent, Test Department. In 1957, Mr Edmundson was appointed assistant manager—manufacturing, being promoted manager—manufacturing on 1 Jan., 1959. On behalf of the company he has visited USA, Switzerland, France and Germany. A past secretary and chairman of the Rugby sub-centre of the IEE, he is now chairman of the Engineering Advisory Committee, Rugby College of Engineering Technology.

At present serving as deputy director of industrial power in the U.K. Atomic Energy Authority's Development and Engineering Group at Risley, **Mr H. Cartwright,** M.B.E., M.A., A.M.I.MECH.E., A.M.I.E.E., has been promoted to director of industrial power. Educated at William Hulme Grammar School, Manchester, and at St. John's College, Cambridge, where he took a First Class Honours degree in the Mechanical Sciences Tripos in 1940. From 1942 to 1946 he was a signals officer on ground radar stations in the RAF, reaching the rank of Flight-Lieutenant. After periods with the Decca Navigator Co. and the English Electric Co., he joined the Atomic Energy Division of the Ministry of Supply at Risley in 1949 as a design engineer. In 1954, on the formation of the Atomic Energy Authority, Mr Cartwright became an assistant chief engineer in the Authority's Industrial Group at Risley. He was promoted to chief engineer in 1955, assistant director in 1956, and became deputy director of industrial power in 1958.

Mr John L. Lutyens has joined the Pressed Steel Co. as group director of research.

Mr J. D. H. Howden has been appointed joint managing director of James Howden & Co. Ltd.

Mr C. R. B. Townend, secretary of Belling and Lee Ltd., has been appointed to the board of executive directors of the company.

Manchester manager for the Dictaphone Co. Ltd. since 1957, **Mr J. Sutton** has been promoted to northern divisional manager. At Manchester he is succeeded by **Mr R. Wightman.**

The BBC announces the appointment of **Mr W. L. Nicoll,** A.M.I.E.E., as engineer-in-charge of the Kirk o' Shotts television and vhf sound broadcasting station, in succession to the late Mr J. Cleland. Mr Nicoll joined the Corporation in 1937 as a maintenance engineer at the Burghead transmitting station. He has held the post of assistant engineer-in-charge of the Kirk o' Shotts station since it was opened in March, 1952.

Mr Alan J. Marles, B.SC., A.C.G.I., A.M.I.MECH.E., has been appointed technical manager of Ransome and Marles Bearing Co. Ltd. as from 1 Feb.

Among those who have agreed to serve on the Advisory Council on the Employment of Prisoners, just set up by the Home Office, is **Mr J. A. Crabtree,** managing director of J. A. Crabtree and Co. Ltd.

Moffats Ltd. have now appointed five new sales representatives. They are: **Mr C. A. W. Baynham** for Bristol and the West Country; **Mr J. Grahame,** based on Nottingham, covering the northern part of the East Midlands Electricity Board area and Yorkshire; **Mr K. A. Warden,** based on Nottingham, covering the southern part of the E. Midlands Board and parts of the Eastern Electricity Board; **Mr A. J. Cartwright,** based on Wolverhampton, covering the Midlands Electricity Board area; and **Mr J. Sheppard,** based on Blackpool and covering Merseyside and Lancashire.

Mr D. Edmundson

Mr H. Cartwright

BRITISH STANDARDS

Electrically conducting rubber flooring. *B.S. 3187:1959. Price 4s.* A new standard which has been produced to meet the requirements for conducting rubber floors in hospital operating theatres, explosives factories or other buildings where static generated on or in the flooring material may create a danger of explosion by discharge in the presence of explosive vapour or dust traces of explosive material. The standard covers natural and synthetic rubber flooring materials in which a proportion of carbon black has been incorporated before vulcanisation in order to reduce the electrical resistance to a safe value for the discharge to earth of static as it is generated. Appendices detail tests for water absorption, method of determining electrical resistance of the flooring when laid and the method of earthing the conducting flooring. The standard has the approval of the Rubber Industry Standards Committee.

Comparison of British and overseas standards for steels. *B.S. 3179:1959. Part 1. Price 6s.* A major difficulty in dealing with export tenders to foreign specifications is a ready comparison between the chemical compositions of materials to home and overseas standards. In this part a table has been prepared which gives the comparative composition and nearest equivalents of British American (SAE) and German (DIN) wrought carbon steels. It is the first of a series which have been authorised by the Iron and Steel Industry Standards Committee and a second, dealing with alloy steels, is in course of preparation.

Copies of the above may be obtained from the Sales branch of the BSI, 2 Park St, W.1.

NEW LITERATURE

Electricity Undertakings of the World, 1959-60

AS probably the only reference work attempting to provide world-wide supply data, this hardy annual occupies a unique position and has often provided useful information in the past. It does not, however, cover every undertaking throughout the world, although each year more statistics are added to make it a little more complete. Nevertheless, it is always a useful reference work. As in former years, the volume is sectionalised into the UK, the Commonwealth, and foreign undertakings, with a comprehensive index of towns, providing a ready reference to the undertaking sought. For most undertakings the data given includes number of consumers, voltages, generating plant and load. Published by Benn Brothers, 646 pages, 8¼ in. by 6 in. Price 30s.

Exporters' Year Book

WITH an increasing number of firms entering the export market, particularly seeking out new territories, the collation of such material as is within the covers of this annual becomes an important task. Again, all the information has been brought up to date, and provided in a form which makes reference to it relatively simple. The information given includes such items as principal banks, holidays, and postal data, in addition to details of the special requirements applicable to goods being imported from the UK—all material which the exporter will find of considerable assistance. Published by Syren and Shipping Ltd., 324 pages, 9¼ in. by 6¼ in. Price 57s 6d.

Practical Electricians' Pocket Book 1960

ed. by Roy C. Norris

SIX new features are included in the 1960 edition of this handbook, which none the less retains its convenient and compact form. They cover public address, for which there is a chapter explaining up-to-date methods for solving "sound reinforcement" problems; a section on characteristics of germanium and silicon rectifiers; and a fresh chapter on accumulators. Principles of refrigeration are backed up by hints on fault finding; there is information on education in electrical contracting and a discussion of electricity tariffs and reasons behind the different types. Other sections of the book are revised to maintain its comprehensive coverage. Amongst the topical sections in this respect is that on space heating which has a discussion of the various type of floor-warming cables in use, and some notes on control of such systems. Published by Odhams, 535 pages, 5 in. by 3½ in. Price 7s 6d.

Cabma Register, 1959-60

THIS seventh edition contains up to date information relating to British industrial products in general required by Canadian industry. It is intended for use by Canadian firms seeking British suppliers of various equipment, and has the official backing of the Dollar Exports Council, FBI and other organisations. More than half the volume, therefore, consists of a buyer's guide, including a French glossary. There follows a lengthy list of manufacturers and distributors, with addresses and Canadian agents, and a collection of proprietary names. Published by Iliffe, 650 pages, 9¼ in. by 7 in. Price 15s.

Recent Advances in Atmospheric Electricity

by L. G. Smith, M.A., PH.D.

DURING 1958, a symposium was organised in the USA at which leading authorities working on atmospheric electricity reviewed prevailing theories and experimental work. The proceedings of the conference have now been published in a handsome volume, with the original papers usefully followed by a summary of the oral discussion that ensued. The result is a most valuable collection of numerical data critically reviewed, together with accounts of the best available explanations for those results. For the power electrical engineer, it is the thunderstorm and lightning results which will have most significance; though his telecommunications colleague will find much of importance in the preceding section entitled "fair weather electricity." For example, there is a paper on the relationship between what are called giant thunderstorms and their accompaniment, tornadoes and the like; and another on equipment for forecasting lightning danger. Additionally, there is information on individual thunderstorms which builds up a picture of the phenomena that accompany them, which makes this scientific study gripping for general reading in many places, as well as a rewarding technological study. Published by Pergamon Press, 631 pages, 9¼ in. by 7½ in. Price 120s.

Aluminium Busbars

by A. G. Thomas, B.SC.(ENG.), A.M.I.E.E., A.M.(AMER.)I.E.E., *and P. H. J. Rata,* B.SC.(ENG.), A.C.G.I.

THE increasing use of aluminium for electrical busbars is an acknowledgment of its excellent electrical and thermal dissipation properties and the economic advantages over copper in price and easier manipulation. That it is not even more widely used must be attributed to a certain conservatism on the part of designers and engineers who have been "brought up on copper" and a dearth of technical literature collating all the necessary data and information for them to refer to. The authors of this handbook have now removed the latter handicap by producing a concise reference work which gives all of the required information with, in addition, photographs of major installations now working satisfactorily which should go far to remove the last lingering doubts. Curves and tables provide all the necessary data for design and there is adequate information on workshop techniques to assist those who have to supervise production and erection. A book for every electrical engineer's library. Published by Hutchinson and Co., 100 pages 9 in. by 6 in. Price 21s.

BOOKS RECEIVED

A Guide to Industrial Film Making, by S. Black. Guide designed to give information to sponsors considering industrial film making. Covers organisation, cost and distribution, and includes lists of distributors and cinemas and a glossary. Published by The Whitehorn Press, 24 pages, 10 in. by 7½ in. Price 7s 6d.

Electronic Computers, by E. H. W. Hersee. Short introduction for the general reader concentrating on principles of operation rather than electronic circuitry. Published by Blackie and Son Ltd., 104 pages, 7¼ in. by 4½ in. Price 12s 6d.

The Lead Storage Battery, by H. G. Brown. Covers construction and characteristics of batteries, includes notes on working, maintenance and testing. Published by John Sherratt and Son, 166 pages, 8½ in. by 5¼ in. Fourth edition, price 24s.

Nuclear Technology for Engineers, by R. H. Ellis. US text-book with accent on radiation topics. Published by McGraw-Hill, 284 pages, 9 in. by 5 in. Price 74s.

Millimicrosecond Pulse Techniques, by I. A. D. Lewis and F. H. Wells. Developments in theory and design of electronic circuits and devices for short-time operation, concentrating on basic circuit elements and items of equipment. Published by Pergamon Press Ltd., 417 pages, 8½ in. by 5¼ in. Second edition, price 50s.

Transformers for the Electric Power Industry, by R. L. Bean *et al.* Reference book by engineers of Westinghouse Electric Corporation giving comprehensive coverage. Published by McGraw-Hill, 409 pages, 9 in. by 5¼ in. Price 97s.

Process Integration and Instrumentation. Outlines in simple form means by which variables occurring in manufacture can be sensed, measured and controlled. Part of EDA "Electricity and the Productivity" series. Published by Electrical Development Association, 204 pages, 8¼ in. by 5¼ in. Price 8s 6d.

Compression and Transfer Moulding of Plastics, by J. Butler. Guide for students of mould design, for designers and moulding shop executives. Published by Iliffe and Sons Ltd., 230 pages, 8¼ in. by 5¼ in. Price 35s.

Electronics, by A. T. Starr. Text-book for London University Engineering degree. New edition extends description of semi-conductors and transistors. Published by Sir Isaac Pitman, 429 pages, 8½ in. by 5¼ in. Second edition, price 35s.

BRUCE PEEBLES & CO.

Progress in Manufacture—1959

DESPITE stiffer competition during the year, a number of interesting orders received for a wide range of equipment plus the uncompleted backlog from 1958 kept the works fully occupied in 1959.

New Orders

Among new orders received by the Rotating Plant Division is one for electrical plant for the Sendzimir steel strip mill which Richard Thomas and Baldwins Ltd. is building in South Wales. This order covers the supply of a 3,720 kW four-machine generator set and a number of d.c. motors with a total output of 3,930 h.p. For another pioneer project, the Lurgi High Pressure Complete Gasification Plant which the Scottish Gas Board is building at Westfield, Fife, the company has received an order to supply a large number of motors ranging from one to 1,800 h.p.

In the Transformer Division a new order of some interest is for four 30 MVA, 220/66 kV three-phase transformers and seven single-phase transformers to make up two 220/22 kV three-phase banks rated at 45 MVA, with a spare single-phase unit, for the State Electricity Commission of Victoria.

The Rectifier Section has also received orders for germanium equipments up to 450 kW for a number of industrial applications.

Orders Completed

During 1959 five generators for North of Scotland Hydro-Electric stations were completed and commissioned, two being 12 MW, 11 kV horizontal synchronous machines at Shin, a 3,500 kW, 3·3 kV vertical slow-speed alternator at Lairg, an 18 MW vertical generator at Orrin and a 2,500 kW induction generator at Cuaich.

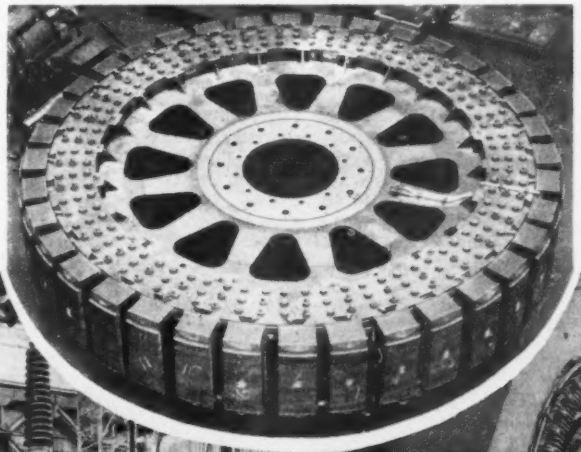
The Transformer Division despatched the first two of three 90 MVA 275/66/11 kV transformers to the Electricity Trust of South Australia to link the main power line between Port Augusta station and Adelaide at Magill. The third of these is in an advanced stage of construction. Delivered but not commissioned are the second of three 144 MVA generator transformers for Kincardine-on-Forth and the last of four 120 MVA 275/132 kV auto-transformers for Clyde's Mill, South of Scotland Electricity Board.

The beginning of 1960 sees workshops busily engaged on 18 MW and 12 MW generators for the Cwm Rheidol project in Wales, the first of four 10 MW generators for Strathfarrar and a 2,200 kW induction generator for Loch Ericht. Export orders in hand include generators for Newfoundland and New Guinea, motors for Lake View, Toronto, and for South America, USSR, the Canaries and India, and an alternator for South Africa.

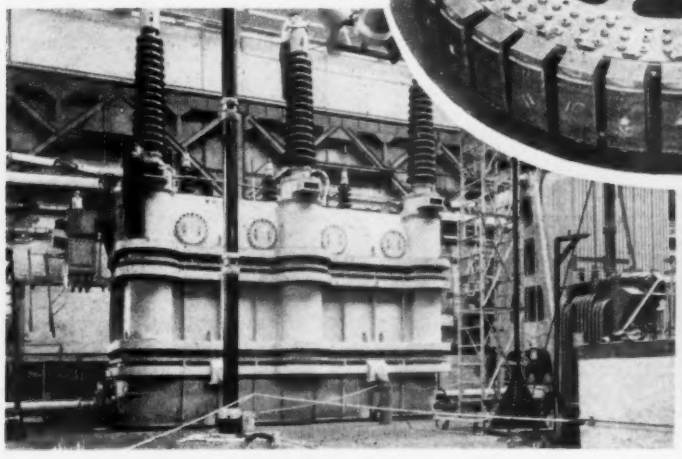
Apart from a number of transformers in varying stages of construction, this year will see the commencement of construction on an interesting home order, eight 12/17 MVA rectifier transformers for the supply of current to magnet circuits of a large proton synchroton at Harwell. The magnet system is split into two halves, each of which will be supplied by four Brown Boveri rectifiers operating in 24 phase. Each equipment will be fed from a rectifier and an interphase transformer to give a six-phase output. The four transformers will be phase displaced by star, delta and extended delta primary connections to give 15° displacement between secondaries which, with inter-phase transformers, will enable the groups to operate in 24-phase.

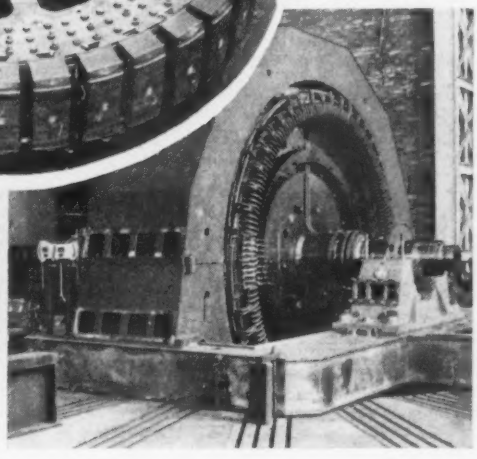
Bottom right: A 12 MW, 11 kV, 375 r.p.m. duct ventilated generator for the Shin project North of Scotland Hydro-Electric Board

Below: A 90 MVA 275/66/11 kV transformer, one of three for the Magill station, South Australia, being prepared for test at the works



Left: The magnet wheel of a 3,500 kW 3·3 kV, 167 r.p.m. alternator for Lairg Dam power station, North of Scotland Hydro-Electric Board





equipment for industry

Water demineraliser

HIGH quality demineralised water in small quantities suitable for the electrical industry can be obtained from a Deminrolit plant which is claimed to give a considerably cheaper supply than a special distilling installation. The plant is made in two capacities with throughputs of either 60 or 135 gallons per hour. It is housed in a cabinet 6 ft high by 1 ft 8 in wide equipped with control panel, conductivity tester and air blower for circulating the regenerants. The equipment is made by *The Permutit Co. Ltd., Gunnersbury Ave, Gt West Rd, W.4.*

Grouped temperature alarms

LARGE cold storage installations which may comprise several cold rooms in which temperature has to be maintained at a predetermined value constitute a typical application for a temperature alarm system recently introduced. The Temp-O-larm system groups together at a central point, alarm indicators operated from individual thermostats in the separate cold rooms. Any variation of temperature outside the preset limits produces an audible warning or visual indication. The system can be arranged to compensate for normal increases in temperature and to be inoperative as an alarm during defrosting periods. The alarm is operated from an a.c. 240 V supply and is energised from power units suitable for a maximum of either 6 of 12 units. A timer can be incorporated to delay operation of the alarm for six hours to permit defrosting to take place. Indication for two cold rooms can be obtained by connecting thermostats in series provided the room temperature difference does not exceed 10% and their defrosting cycles take place at the same time. Although developed for cold storage plants, the system is said to be applicable to chemical processes, greenhouses, and a number of other processes where warning of temperature variation is essential. Details may be obtained from *The Walter Kidde Co. Ltd., Belvue Rd, Northolt, Middx.*

Aircraft rectification unit

MEETING the rigorous altitude and acceleration conditions experienced by equipment in modern aircraft calls for a compact, rigid construction. A d.c. power pack to meet such conditions has recently been introduced. The unit incorporates a two transformer arrangement with an interphase reactor to give a low ripple content in the output. It provides 15 kW at 27 V d.c. from a 200 V a.c. supply which may be in a frequency range from 320-500 c/s. The unit is fan cooled, measures 25 in. by 8 in. by 10 in. and weighs only 54 lb. It is made by *The Plessey Co. Ltd., Ilford, Essex.*

Car engine speed indicator

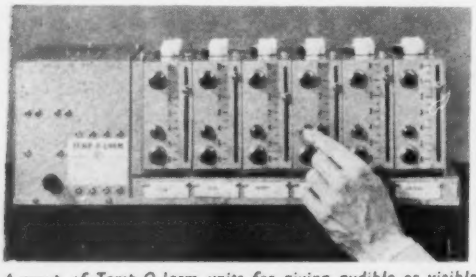
MOTOR rally enthusiasts are well aware of the importance of knowing accurately their engine speed, but such an indication can also be of value to motorists who prefer to travel at a more leisurely pace. A speed indicator recently introduced, in addition to showing engine revs directly, is also claimed to give the motorist a useful indication of the best adjustment for his ignition and carburetter systems. The meter operates from the car electrical system and requires no mechanical connections to the engine. A transistorised printed circuit is used which responds to signals picked up in a wire wound on the ignition coil lead. As engine speed increases, more signals are received and meter deflection increases accordingly. The only other connections required are to the car battery. All circuit components are mounted in the indicator which has a 3½ in diameter scale, claimed to give an accuracy of ±3%. The indicator is voltage and temperature compensated and although it works from the ignition circuit there is no direct connection and no interference with ignition performance. The company also manufacture several other accessories for the motorist including battery testers and chargers. Further details may be obtained from *Crypton Equipment Ltd., Bridgwater, Somerset.*

Impulse relay

SPRING operated contacts are alternately made and broken by application of a succession of d.c. impulses to a relay now available. In addition to the spring operated contacts the relay has a further group of contacts which close and open with the armature. The relay is designed for d.c. circuits up to 150 V and can be supplied for a.c. circuits by the addition of a rectifier and smoothing capacitor. It can be supplied as a wireable or plug-in unit, open or with a plain enclosure or hermetic sealing. The open version has two changeover contacts on each group, but the enclosed version has a maximum of three changeover contacts with only one set spring-operated. Overall dimensions are $1\frac{1}{16}$ in. by 1½ in. by 1¾ in. Information can be obtained from the makers *Magnetic Devices Ltd., Newmarket, Suffolk.*

Line tap connections

A WELL-KNOWN supplier of heating apparatus and many other small electrical accessories has recently announced a new introduction. This is a series of line taps made in France and suitable for joining or tapping-off wires and certain sizes of busbar. The line taps are fully insulated and are said to be suitable for 500 V circuits. They are made in a range of sizes for current ratings from 15 A to 110 A. The conductor is clamped under a wedge bar by pressure from a screw so avoiding pinching the conductor with the screw. These line taps, which are insulated by a resin moulding, can be supplied either for direct suspension from the conductor or for board mounting. They may be obtained from *Metway Ltd., Canning St, Brighton 7.*



A group of Temp-O-larm units for giving audible or visible warning of temperature changes in refrigerating cabinets. The unit shown monitors 6 cabinets and includes compensation for temperature increase during defrosting cycles

Car engine revs are indicated on this transistorised meter requiring only three electrical connections and no mechanical coupling to the engine

Insulated line taps for current ratings between 15 A and 110 A are available from Metway. The taps can be of the board mounting or standard type and are said to be suitable for 500V working

for the electrical trade

Price change

A REDUCTION in the price of the Ekco 2 kW, low level "Minora" wall-mounting fire is announced. The new price is £4 8s 7d, including 13s 7d purchase tax, a reduction of 25s 1d. This has been made possible through the large demand for this unit on housing estates which has enabled production and distribution costs to be reduced. The makers are *E. K. Cole Ltd., Southend-on-Sea, Essex.*

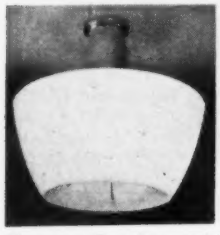
The "Dhobi-dri"

AN unusual and compact clothes dryer and airer which can be folded away when not in use, the "Dhobi-Dri" is bound to appeal to those in flats and small houses where space is limited. It comprises a four-sided framework, not unlike the old-fashioned wooden clothes horse but in welded steel heavily coated with durable waterproof plastic. A number of plastic coated bars laid across the top of the frame provide support for the clothes and a plastic curtain can be wrapped around the exterior when used for drying in association with the 1 kW heating unit, a totally enclosed convector specially designed for the purpose but also adaptable for other heating duties. Open, it stands 40 in. high by 24 in. square and provides 40 ft of hanging capacity. It folds to 2 in. in width and is priced at £7 19s 6d with heater or £5 without, both prices including purchase tax. The makers are *Lewis Utilities Co.*, 17 *Northburgh St, London, E.C.*1.

New lighting units

THREE new general purpose tungsten filament lighting units in the Troughton and Young range have just been released. They are virtually the same lighting unit arranged for tube or flex suspension or for attachment close to the ceiling. The opal glass diffuser is suspended from a cadmium plated support spider attached to the ceiling plate or lampholder, and the Edison screw lampholder is masked where it emerges from above the diffuser by a silver anodised aluminium cover, also supported on the spider. An opening at the base of the diffuser enables a proportion of the light to shine downward without diffusion and the cut-off angle of 45 deg ensures that the lamp bulb is not visible from any normal viewing position.

The fitting is designed for use with 150 or 200 W lamps with a spacing height ratio of 1·5 to 1. Designed to meet Ministry of Education requirements, it is particularly suitable for schools. Prices are 36s 9d, tubular suspension (S.22), 35s, flex suspension (S.21) and 29s 8d for ceiling attachment (S.20) all prices including purchase tax and e.s. lampholder. A descriptive leaflet is obtainable from the makers, *Troughton and Young (Lighting) Ltd.*, 143 *Knightsbridge, S.W.*1.



The suspension fitting Cat S.22

The new "Troughton and Young" suspension and ceiling fitting for use with 100/150 W Edison screw lamps

Two-height 'fridge

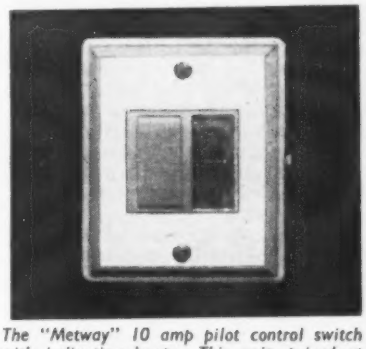
A NEW absorption refrigerator to a Swiss design is now ready for marketing under the name "Harper." It is of 2·5 cu ft capacity with 4 sq ft of shelf area and stands 28 in. high. The finish is white stove enamel and there is storage space on the inner side of the door for milk and eggs.

A sheet steel stand 7 in. high will raise the working height of the refrigerator, without affecting its unit appearance, to 35 in. or it can be wall mounted. Further details can be obtained from the agents, *John Harper and Co. Ltd., Albion Wks, Willenhall, Staffs.*

Three-way adaptor

THE increasing use of the ring-main and 13 amp three-pin outlets with the flat pins and sockets poses a problem when applied to houses in which there are already a number of the older pattern round-pin sockets with their matching plugs on appliances. There is also the case, on which comment has already been passed in these pages, where the number of the flat-pin outlets in new houses is inadequate for the average person's requirements. Faced with the cost of installing additional outlets in each room, with the ensuing mess and disorganisation, many will give a hearty welcome to a three-way adaptor which has just been put on the market.

This will convert a single switched outlet to a three-way outlet, one of the ways being for a 5 amp three-pin plug of conventional pattern. Since these are not fused, a quick-change fuse for this outlet is incorporated. The 13 amp outlets have not this protection as all approved flat-pin plugs incorporate their own fuses. The price of these adaptors is 10s 9d in brown, or 12s 3d in white. They are made by *Grelco Ltd. of Minehead, Somerset. London Office,* 123a *Gloucester Rd, S.W.*7.



The "Metway" 10 amp pilot control switch with indicating lamp. This unit, priced at 13s 8d, was described in our 31 Dec. issue, page 829

TRADE PUBLICATIONS

AWCO. Two brochures in colour: one, "Seven over the Severn" (OT.30), describing the CEGB supergird span over the River Severn; and the other (G.25), detailing the company's products from the Aluminium Wire and Cable Co., Port Tennant, Swansea, Glamorgan.

CATTERSON-SMITH. Leaflet detailing prices and sizes of stock patterns of tube furnaces from R. M. Catterson-Smith Ltd., Exhibition Grounds, Wembley, Middx.

ERICSSON. Leaflet (P5907/4) describing the new miniature lever keys from Ericsson Telephones Ltd., Beeston, Notts.

ISOPAD. A 43-page catalogue listing the range of "Isopad" electric surface heating pads, tapes and mantles, with technical data, from Isopad Ltd., Barnet By-Pass, Borehamwood, Herts.

JOHNSON, MATTHEY. Six-page leaflet giving information on the rare earth elements (lanthanons) in production by Johnson, Matthey and Co. Ltd., Hatton Garden.

MORGANITE. Six-page brochure giving technical data on "Morganite" carbon bearings from Morgans of Battersea (Morgan Crucible Co. Ltd.), Battersea Church Rd, S.W.11.

NU-SWIFT. 94-page technical booklet (Cat. 333) on "Nu-Swift" fire-fighting equipment from Nu-Swift Ltd., Elland, Yorks.

PILKINGTON. Two leaflets on disc type glass suspension insulators from Pilkington Bros. Ltd., Ravenhead Wks, St. Helens, Lancs.

ROCOL. Seven duplicated sheets listing typical uses of molybdenised lubricants in the coal industry from Rocol Ltd., General Bldgs, Aldwych, W.C.2.

Rapid detection of fire

CONTINUOUS CURRENT MONITORING SYSTEM INSTALLED AT HOOVER'S

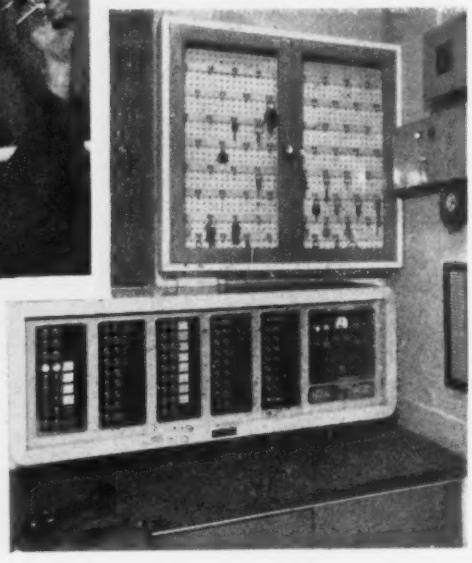
THE most important factor in successfully handling outbreaks of fire in a factory, is speedy information of the outbreak so that it can be dealt with while it is still small. An electrical system giving this rapid detection has recently been installed at the Perivale works of Hoover Ltd. and a practical demonstration provided at a visit on Monday gave a good indication of the speed of detection.

The system which cost some £20,000 and covers an estimated 215,000 sq ft area, was designed and installed by Sound Diffusion (Auto-thermatic) Ltd. It is based on the principle of continuous current monitoring of a number of ring circuits. Heat-sensitive detectors connected in these rings open the circuit when a certain temperature has been reached, cutting off the current to de-energise a relay which closes a secondary alarm circuit. The practical demonstration consisted of lighting petrol-soaked paper in a pan in a small room. The alarm sounded 6 sec after the paper had been lighted.

There are three types of detector: fusible link, break-line and rate-of-rise. As their names imply, the first two incorporate a low melting-point junction which fuses to open the circuit. The third, which is more sensitive, makes use of bimetal strips, but is also backed up by a fusible link. The detectors are set to operate at temperatures between 120°F and 135°F, depending on ambient.

The detectors are connected in the central core of plastic-insulated coaxial cable. The outer wire braiding of the cable is also continuous and forms a second ring circuit quite separate from the first. This arrangement produces an alarm signal should the inner become short-circuited to the outer. The rate-of-rise detector operates initially to short-circuit the inner to the outer rather than break the circuit. Should the temperature rise further, however, it will then break the circuit completely.

Some 2,000 detectors have been installed throughout the Hoover works, distributed between 26 sections, each section forming one ring circuit. Their main factory building is a multi-storey block and it has been found convenient to divide each floor into three sections. Operation of any detector, sets off audible fire alarms throughout the factory. It also gives visual indication at the central fire control room of the particular section involved. The duty fire control officer announces the location of the section over the public address system, so that the fire brigade can then make immediately for the area.



Top picture shows one of the Auto-thermatic fusible-link detectors being installed at Hoover's, depicting the coaxial cable connections. Right is the central control panel, giving visual indication of each section of the system to pinpoint location of fire outbreaks

TRANSFORMERS FOR BRIDGES

ALTHOUGH measuring bridges can be discussed in terms of the well-known lattice or diamond structure of the Wheatstone Bridge, it is more fruitful, and simpler, to think in terms of voltages and currents, or so Mr C. G. Mayo, M.A., argued in opening a discussion at a meeting of the IEE Measurement and Control Section on Tuesday evening. His contention was that transformers provided an easy and precise way of superseding the more conventional resistance ratio arms.

He showed that by thinking in terms of voltage and current, the chief requirement in bridge measurement was to provide two voltages equal in magnitude but opposite in phase, which could be done with transformers without difficulty. Moreover, the two voltages need not necessarily be equal and opposite; they could be in any desired ratio. Similarly, by the use of a second, "current," transformer, it was possible to provide detection for currents also of any desired ratio and not necessarily equal and opposite.

Hence, at balance, the unknown admittance, Y_x, could be made equal to the known admittance Y_s. Alternatively, it could be made equal to abY_s, where a, b were the voltage and current ratios, respectively. Therefore, it was possible to make the ratio of the unknown impedance to the standard have any value that was found convenient.

Although the transformer was initally considered ideally as a voltage source of zero impedance, in practice, transformers have series, or leakage, impedances and also shunt impedances which draw currents from the supply other than useful or load currents. Such unwanted currents, as well as the load currents, may react with the leakage impedance to give no-load errors in the voltages derived from the transformer.

A bridge with impedance ratio arms, however, has comparable errors and these, moreover, are fixed. In transformers, deviations from the ideal can be reduced to meet almost any required tolerance. Transformer bridges have been made with errors of the order of 10^{-8}, to take bridge precision beyond any standards previously existing. A further advantage of transformer bridges over impedance bridges is a figure of merit several thousand times greater.

The low source impedance of the transformer bridge gives another substantial advantage, since it is usually so small that the transformer ratio is unaffected by stray capacitances, and little affected by shunt elements in the unknown structure, provided these elements are returned to the bridge neutral. Thus three-terminal measurements are easy.

PROBLEMS AND PRACTICE

We welcome contributions to this feature; those published will be paid for at our standard rates. There must be many problems encountered in day-to-day electrical work, or useful ideas or tools devised to make it easier; all make instructive reading.

Drill tip

ELECTRICIANS are often called upon to drill non-ferrous metals and invariably do so with the conventional high-speed twist drill. This can, and often has, led to dangerous snatching taking place between the drill and the

Regrinding of twist drill to make tip suitable for cutting non-ferrous metals

work, the results of which range from an imperfectly formed hole to broken fingers and wrists.

A method the writer has used with success to overcome this difficulty is to regrind the drill in the manner shown in the sketch. The overall effect is to reduce the cutting edge of the drill and increase the cutting angle to give the effect of a straight-fluted drill.—*R.T.C.*

Grinding-in

MY reaction to the various expediences of grinding and lubricating lampholder shade rings, referred to under the above heading (17 Dec., 1959; 7 Jan., 1960) was to expect that any oily type of lubricant would have had a deleterious effect on the "Bakelite" or similar material in which the lampholder is made. I do not recall ever coming across tight threads in *new* lampholders of reputable make but lampholders which have been in use for some time develop so many faults that the safest plan on maintenance work is always to carry ample supplies of spares.

In cases where the moulding has become cracked or distorted due to the heat from the lamp, so that it is almost impossible to remove the shade ring—let alone replace it again—I have found that a little dry graphite, as from a soft lead pencil, applied to the threads, has a wonderful effect. After all, practically every electrician carries a stump of lead pencil with him, if only to make out his time sheets.

In my opinion "Bakelite" and similarly shrouded lampholders have but two advantages over brass holders with porcelain interiors: they are relatively shock-proof and easier to fit—usually. On the other hand, they have a life expectation, I should estimate, of one-tenth of that of the brass-porcelain type. The only situations where brass lampholders have been comparatively short-lived are in places like bathrooms and kitchens where steam and/or gas fumes have played havoc with the metal.

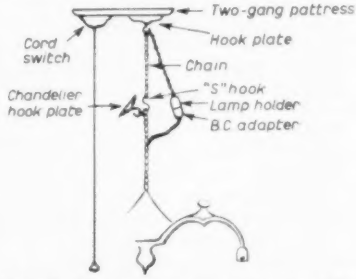
The trouble seems to be that lamps have developed in power (and consequently, heat emission) but the makers of lampholders and flexible cords have not yet caught up with them. In other words, there seem to be neither heat-resisting flexibles nor lampholders available for ordinary domestic and business applications, not forgetting heat-resisting flexible cords for special purposes.

I remember the time when the life of a flexible cord was determined mainly by the quality of rubber used and the ambient temperature to which it was subjected, but in these days when a 40 W gas-filled lamp is practically the smallest size used in an ordinary household, it is only a comparatively short time before the flex nearest the lamp becomes hard and brittle like a dead twig and is liable to break, or short-circuit, when some misguided person tries to clean the shade. Shades should *never* be cleaned!—*R. St.C.Ison.*

Detachable fittings

I WAS called in to answer an inquiry from one of those art gift shops which are becoming so popular nowadays. They were branching out to include the sale of electric chandeliers. For display purposes the shop required these to be illuminated; at the same time the fittings were to be readily detachable from a rather high ceiling, in the event of a purchaser wanting to take one home.

To meet this requirement I devised the method shown in the accompanying diagram. As can be seen, it involved fitting a two-gang pattress to the ceiling, carrying a single-hook plate together



Method of temporary suspension for chandelier fittings utilising S-hook, b.c. adaptor and cord-operated switch

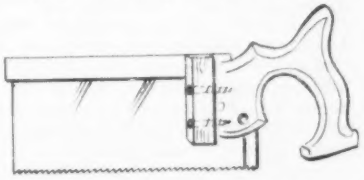
with a cord-operated switch. Approximately equal lengths of chain and of flexible cord were suspended from the hook plate, the chain being terminated by an S-hook, the flexible by a b.c. lampholder.

The chandelier may then be suspended from the arrangement by looping the S-hook through one of the links of its own suspension chain. A b.c. lampholder adaptor temporarily connected to the end of the chandelier flexible provides means to make a detachable electrical connection. The arrangement has the further advantage that when the suspension point is not being used for a chandelier, it can still be used for illumination or display purposes by fitting a lamp and shade to the holder.

It was not thought necessary to fit a b.c. adaptor with earthing connection. The chandeliers are hung out of reach of the occupants of the shop and therefore do not infringe IEE Regulation 403(ix); the floor is virtually earth-free, being wood-boarded with a linoleum covering.—*"Michet."*

Adaptable tools

WHEN one is a journeyman electrician, it is always an advantage to carry tools which are capable of being used on various jobs. It minimises the inconvenience, in terms of weight, of carrying too many tools, which often



Rectangular block of metal, screwed to squared-off edge of handle quickly adapts tenon saw for use as a square

means carrying duplicates, although in the long run this is probably less of an inconvenience than carrying too few tools. Few readers need to be reminded of the horror of unpacking the tool kit to discover the absence of a vital tool.

Some years ago I adapted my tenon saw to serve a dual purpose. I squared up a rectangular piece of metal, drilled it and countersunk the holes. The handle of the saw was trimmed to make a right-angle with the saw back, this handle edge then being faced with metal by securing the block to it with two screws, as depicted in the diagram. This gave me a square, which is always a useful tool on any job.—*F.R.R.*

News of the Week

LOW FINANCIAL RETURNS ON CANADIAN INVESTMENTS

Basil Z. de Ferranti's plea for Local Preference

ARE subsidiaries of British firms in Canada losing money? According to Mr Basil Z. de Ferranti, director of Ferranti Ltd., who returned last week-end from a visit to the Dominion, "many overseas investors have been losing their shirts in Canada."

He admitted that Ferranti's own subsidiary—Ferranti-Packard Electric Ltd., of Toronto—representing a $10 million investment, was not returning as much on the capital as it should.

He told members of the Empire Club in Toronto that "Canada is an extraordinary pleasant country whose inhabitants combine the brisk and exciting atmosphere of the new world with the traditions and culture of the old and who sit on top of untold natural wealth.

"But they sit there a bit like sirens luring unsuspecting overseas industrialists with the chimera of untold wealth to slowly dissipate their shareholders' substance or to tolerate for years a return on capital employed of 2 or 3%."

Failure to show strong preference for Canadian-made goods provided little encouragement for overseas investors in that country, he went on.

Mr de Ferranti admitted to a conflict of interests in the matter of overseas trade. On the one hand he was a fervent believer in competition, free trade and everybody buying overseas, especially from England. But as a Canadian industrialist responsible for investment in that country of around $10 million, "he was a fervent advocate of high tariff protection of secondary industries, restricted competition and a generous outlook among our customers."

More Capital Expenditure This Year

INCREASED capital expenditure this year by industry is forecast by the Board of Trade. Estimates show that private industry and business plan to spend 14% more than in 1959 on fixed assets for use in manufacturing industry, and about 20% more on assets for other industries and services. Overall capital expenditure is expected to rise by 16% in contrast to the slight fall forecast last summer.

The 14% increase in manufacturing assets is made up of 17% on plant, machinery and vehicles, and about 8% on building work. Other industries show a rise of a fifth in outlay on plant and machinery and a third on building.

Scottish Tariff Battle Again

THE next stage in the lengthy tariff battle between British Oxygen Co. and the South of Scotland Electricity Board started again on Tuesday when Lord Guest began the hearing of evidence in Scotland's Court of Session. This time, the hearing is concerned with proof that the board's electricity tariffs discriminated unduly against high voltage consumers. The company have claimed repayment of £10,000 alleged overpaid between 1952 and 1955.

Shoddy Appliance Reports Wanted

DOMESTIC appliances are among the products, which include textiles, carpets and footwear, to be scrutinised by the Board of Trade Committee on Consumer Protection when it has completed its study of safety standards. This time the committee will be examining complaints of "shoddy, defective or unsuitable" goods to determine what kind of weakness lies at the root of the trouble.

The chairman of the committee, Mr J. T. Molony, Q.C., is now calling for evidence to be submitted "as to the prevalence of difficulties, the practicability and desirability of the various methods by which they might be removed, and the steps which would have to be taken to make those measures effective." Letters should be sent to the secretary, Mr S. W. T. Mitchelmore, Board of Trade, Horse Guards Ave, S.W.1, not later than 14 March.

The BoT receive more complaints about appliances, textiles and footwear than any other kind of goods.

The South Bank Electricians' Strike

RECOMMENDATIONS being made by the committee investigating the dispute causing the four-month strike at the Shell-Mex site, South Bank, could have major repercussions throughout the electrical contracting industry. 130 electricians employed by F. H. Wheeler and Co. at the site claim a bonus to bring their pay up to that of 12 electricians employed there by Sir Robert McAlpine and Sons, the main contractors (McAlpine's are not members of the NFEA.)

Evidence concerning the cause of the dispute was given in public, but when it came to the matter of recommendations which should be made to the Minister of Labour, Mr Roy Wilson, chairman of the Committee of Inquiry, decided that the views of both parties should be given in private.

Electricians employed at the site by McAlpine's received a bonus of £2 15s a week, plus radius allowance of 5½d for each mile between the site and the employment exchange nearest their addresses. Those employed by F. H. Wheeler and Co. received only the standard rate. Mr F. Haxell, general secretary, Electrical Trades' Union, admitted that the national agreement made no provision for such bonus payments, but claimed that at other sites such payments had been arranged without prejudice to existing agreements because of certain special circumstances.

Representing the employers, Mr L. C. Penwill, director and secretary of the National Federated Electrical Association, emphasised that the national agreement made no provision for such bonuses, but there was provision for merit payments covering special skill, special responsibility or long service.

In 1955 exactly the same claim was made in regard to electricians working at Television Hse. The claim went to the Industrial Disputes Tribunal who rejected it.

The union admitted that the South Bank job differed in no way from many other jobs as to the nature of the work, and skill and responsibility required. If recommendation was made for some payment at the South Bank, it would spread within 24 hours to every Wheeler job in Britain, Mr Penwill maintained.

Mr Haxell has made it clear that what is behind this is an application for a general increase in wages, particularly where builders are operating payment-by-result schemes, Mr Penwill went on. He urged that consideration should not be confined to the South Bank site. To concede the claim would in one fell swoop ruin the sanctity of the wages agreement in the industry. That might be what is sought, but it would mean chaos in the industry.

MORE REPORTS FROM THE BUSINESS FRONT : BIDS, ACQUISITIONS, LINKS, MERGERS

M.I. Tops E.M.I. bid for Lancashire Dynamo

METAL INDUSTRIES LTD. have raised their offer to obtain control of the Lancashire Dynamo group. Mr John Black, deputy chairman, announced the new offer on Tuesday. Worth about £12 million, it tops last week's £11·6 million bid by Electric and Musical Industries which was made as a counter bid to the £9·8 million offer of Metal Industries announced on Christmas Eve. For every £1 Ordinary Lancashire Dynamo share, Metal Industries now offer one MI Ordinary plus 12s cash, or half of one MI Ordinary plus 45s cash. For every £100 5¼% Cumulative Preference stock they offer 120 5% Cumulative Preference £1 in MI. Holders of the Ordinary stock would receive a final dividend of 10% for the period to 31 March next, and thereafter the dividend on MI shares they hold.

In effect, the new Ordinary offer, worth about 82s 10½d under the first scheme, or 80s 5d for the alternative, is 33⅓% up on MI's original bid.

The Board of Lancashire Dynamo Holdings last week recommended acceptance of the earlier EMI offer, under which stockholders would get 42 Ordinary EMI 10s shares for every £100 LD Preference stock and 150 Ordinary EMI 10s shares for every £100 LD Ordinary. Thus, the bid is worth about 76s per LD Ordinary unit and 21s 3s per Preference unit.

It seems that EMI had been discussing the possibility of co-operation or amalgamation with the Lancashire Dynamo board for over a year, and discussions were in progress when Metal Industries made their offer, but the latter concern approached the LD board over 18 months ago. The board of EMI consider that the industrial productive capacity and experience of Lancashire Dynamo together with the research facilities of EMI will greatly strengthen the position of the combined companies, especially in the electronic field, where especially in the electronic field.

Rolls Razor link with Electromatic

ROLLS RAZOR LTD. are to manufacture and distribute Electromatic washing machines and other products. This link between the two companies, to which we referred in our 14 January issue, was announced last week by Rolls Razor, and was the first indication of the company's future plans since dealings in their shares were suspended on 9 January following a sharp rise in price during preceding weeks.

Rolls Razor have now applied to the Stock Exchange for requotation of their shares. No statement has yet been made regarding the terms of the agreement between Rolls Razor and Electromatic.

Advertisements have already appeared in the national Press presenting a £52 Rolls-Electromatic combined washing machine and spin dryer, to be supplied direct to consumer from factory. The advertising budget for 1960, reported to be £200,000, indicates the scale of future activity. Four-fifths of the Rolls Razor factory at Cricklewood, N.W.2, is to be used for the manufacture of washing machines and other domestic products which Electromatic are planning to introduce.

Rolls Razor has shown a trading loss over the past four years and was taken over last December by Equity and Share Co. (London) Ltd., who acquired some 70% of the company's shares. Electromatic, started in 1958 with a capital of £100, has achieved considerable success, and now has nine depots and 120 salesmen.

REYROLLE-PARSONS MERGER

A CLOSER integration of the businesses of A. Reyrolle and Co. Ltd. and C. A. Parsons and Co. is proposed under an arrangement involving the formation of a holding company, put forward by the boards of the two companies. Reyrolle's own 40% of the equity of Parsons, but this association produces technical difficulties on the legal side, it is pointed out. It is suggested that the share capital of both Reyrolle's and Parson's would be vested in the new holding company, but the two operating firms would trade as separate entities with their own managements and their existing works.

Integration would strengthen the existing commercial and technical collaboration taking advantage of the fullest extent of the diversity of products, while providing the advantages and economies of a unified organisation, the chairman of the two companies state. The proposals are now being worked out in detail.

Issued capital of C. A. Parsons amounts to £9·6 million, and of A. Reyrolle and Co., £5·48 million, the total assets of both firms at the end of 1958 being valued at £27 million and £28½ million, respectively. There are, of course, a number of subsidiary and associated companies of both concerns, which would also be involved.

OTHER ACQUISITION NEWS

Elliott-Automation Ltd have bought for cash the nucleonic instrumentation business of Isotope Developments Ltd., including its laboratories and works at Beenham, near Aldermaston. The acquisition does not include Isotope's subsidiary, R. A. Stephen and Co.

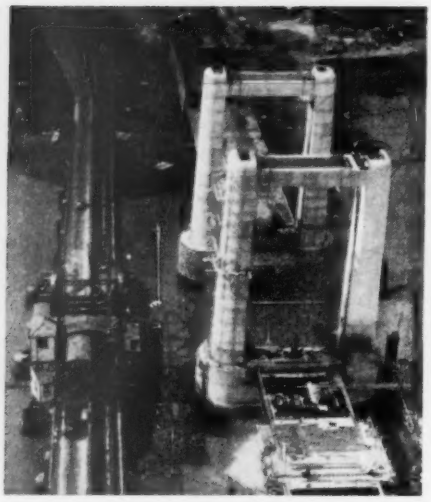
The Elliott-Automation group have also acquired for cash Black Automatic Controls Ltd., manufacturers of a wide range of control valve and pressure regulating equipment. With this latest acquisition the E-A group, which owns 25 companies operating in the field of automation, now has four companies producing control valves of various kinds.

A total of 1,182,148 of the 1·2 million Ordinary 1s shares of Sterling Electric Holdings Ltd. has been bought for cash (at 4s per share) by Land and General Developments.

Visitors are welcomed at the N.E. Regional premises of the British Lighting Council (Northgate House, St. Mary's Place East, Newcastle upon Tyne) which has recently been redecorated, and may discuss lighting problems with Mr. R. A. Hall, the regional engineer, by appointment (tel: Newcastle upon Tyne 21245). Picture shows the "new look" demonstration shop window

Take-over behaviour to be studied

THE standards of behaviour of company directors in such matters as take-over bids are among the questions to be studied by a committee set up by the Institute of Directors. The committee, which will examine the "duties and responsibilities" of directors, will be under the chairmanship of Sir Edwin Herbert, recently a member of the Royal Commission on Local Government in Greater London, with eight members holding key posts in industry, commerce and finance.



ELECTRIC BRIDGE TO ISLE OF SHEPPEY

An aerial view of the new £1 million Kingsferry Bridge over the Swale, linking the Isle of Sheppey with the Kentish mainland, and the old bascule-type bridge, which is due for demolition, alongside. The lifting span, to be completed this month, consists of a single-line of railway track, a 24 ft wide road and a 6 ft wide footpath, controlled by d.c. electric motors with a diesel generator for emergency use. Some 14,000 yards of p.v.c. cables for the installation were supplied by BICC, and the electrical work was carried out by J. A. Wood, electrical contractor, of Peterhead, Aberdeenshire

More Trade Talks next Month

A TWENTY-NATION committee is to meet in Paris next month to discuss outstanding trade problems, giving priority to the EFTA 7 and ECM6 European trading blocks. The committee will have a permanent chairman, a secretariat, and working parties. This is the next step following last week's talks in which the 20 countries of the OEEC took part.

Later, on 19 April, there will be a meeting of senior officials of the 20 countries in Paris to consider an "improved" form of OEEC. A group of four officials from Britain, France, USA and Greece will be appointed to prepare working reports.

Aid to underdeveloped countries is to be co-ordinated by a further group consisting of Canada, France, Germany, Italy, Portugal, Belgium, USA, Britain and a representative of EEC.

The trade talks were obstructed by fundamental differences of opinion concerning the rival trading groups in Europe, and agreement was reached on the subject of the "Six" and the "Seven" only after much step by step opposition. Mr Douglas Dillon, American Under-Secretary of State for Economic Affairs, told the meeting: "We believe that the European trade question is an urgent one and requires the earliest possible attention."

Appliances down in Area Board Sales

THE relaxation of hire-purchase controls at the end of 1958 is reflected in the latest sales figures for domestic appliances issued by area boards. For November, 1959, almost all show a marked drop as compared with the same month in the previous year when instalment buying was stimulated by freed credit. The figures for the 12 months ended 30 Nov., 1959, show a truer picture of the situation, however. Refrigerators and washing machines show a striking gain over the previous year.

Domestic Appliances	Sales in month ended 30 Nov., 1959		Sales in 12 months ended 30 Nov., 1959	
	Total	% change over Nov., 1958	Total	% change over previous 12 months
Cookers ...	31,559	— 2·3	336,553	+ 33·0
Water Heaters:				
Immersion	8,141	— 6·4	190,881	+ 17·7
Storage ...	5,505	+10·8	59,903	+ 25·1
Washboilers	5,005	−27·0	68,164	−15·7
Washing Machines ...	12,793	−33·9	168,377	+ 82·2
Refrigerators	5,515	−28·9	166,538	+138·5

It should be remembered that appliance sales by area boards represent only a part of the total sales over the country.

Electric Heating Advantages

COMBUSTION efficiencies quoted for fuel-fired equipment are often based on laboratory tests and are seldom achieved in practice. Students at a post-graduate course on electro-heat at the College of Advanced Technology, Birmingham, received this warning from Electricity Council member, Mr C. T. Melling, who was delivering the opening address to the course. He stressed that to get optimum results from fuel-fired equipment requires supervision by a combustion expert, whereas electric heating equipment can function unattended.

In addition, electrically-heated equipment can in general be more efficiently heat-insulated. As a result of this and other advantages, net cost of heating by electricity is sometimes less than that of fuel-fired equipment. Aside from cost considerations, electricity is often essential for the cleanliness and the accuracy of control it makes possible.

Mr Melling gave several examples of applications of electric heating where the qualities of electric techniques are money savers. Vitreous enamelling is one case. Electric heating for furnaces reduces the number of rejects and permits less stringent inspection processes, savings outweighing the extra direct costs for fuel involved.

Induction heating of billets before forging is so rapid that it saves steel by not forming scale to the same degree as with other methods; and there is a substantial reduction in loss of zinc in brass melting furnaces if electric induction methods are used.

Dielectric heating is the only method which can be used with plastics and leave the outside visible surfaces of plastics sheets in their original condition.

OUTLOOK FOR EXPORTS — by G.E.C.

NO striking change in the overall pattern of British electrical exports of all kinds to 34 major overseas markets throughout the world is forecast for the first quarter of 1960 in the latest *GEC Export Guide* published last week.

Countries continuing to import more electrical equipment of all types from the UK include Ceylon, Rhodesia and Nyasaland, Ghana, Hong Kong, Kenya, Nigeria, USSR, USA and West Germany. Declining exports are recorded to Argentina, Finland, France, Malaya, New Zealand and Portugal.

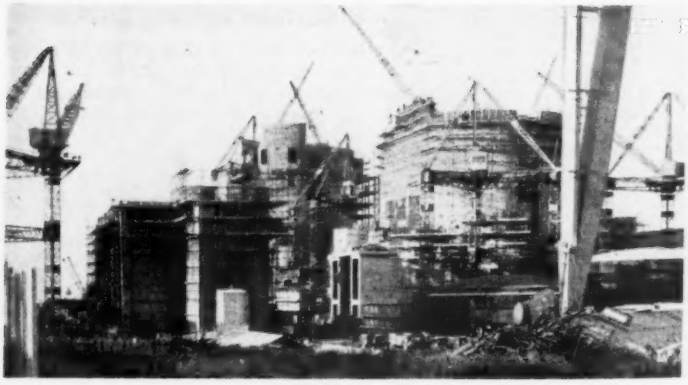
Specific categories of equipment with export prospects are:

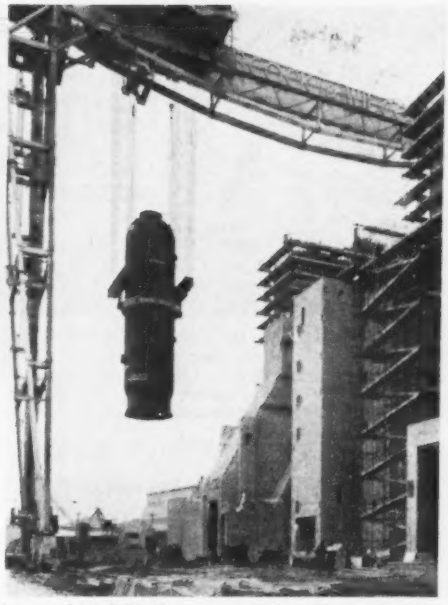
Generating sets, etc.: *Improving*—Rhodesia and Nyasaland, Ghana, Hong Kong, Kenya, Portugal, Spain, USSR, USA, West Germany; *declining*—Argentina, Canada, Ceylon, France, Italy, Jamaica, Malaya, Netherlands, New Zealand, Norway, Venezuela.

Transformers, switchgear, etc.: *Improving* — Argentina, Australia, Ceylon, Rhodesia and Nyasaland, Finland, France, Ghana, Iran, Iraq, Italy, Kenya, Portugal, Spain, USSR, USA, West Germany; *declining*—Belgium, Canada, Jamaica, Malaya, Netherlands, New Zealand, Nigeria, Norway, Venezuela.

Cables, wires, etc.: *Improving*—Rhodesia and Nyasaland, Ghana, Hong Kong, Kenya, Switzerland, USSR, USA, West Germany; *declining*—Argentina, Australia, Belgium, Canada, Eire, Finland, France, India, Iran, Iraq, Italy, Malaya, Netherlands, New Zealand, Nigeria, Norway, Portugal, Spain, Venezuela.

The outlook for exports generally in 36 major product groups is good in 21 countries, improving in four, and unchanged in nine. According to the *Export Guide* there are no markets in which the situation is deteriorating or bad since the last issue in Oct., 1959.





Pictures show (left) the two reactors under construction at Hunterston, with the charge-machine maintenance building rising on the left; and (above) lifting the first of the 12 steam raising units into position at Hinkley Point

PROGRESS AT HUNTERSTON AND HINKLEY POINT

STATEMENTS from two of the nuclear groups this week claim steady progress with work at power stations. The Hinkley Point station has reached a significant point with the first steam raising unit shell lifted into position; and at Hunterston, the return to work of the welders is the occasion for a survey to show how much construction has gone forward while work on the reactor vessel has been delayed.

The Hinkley Point s.r.u. weighs 325 tons, and is 90 ft long, 21 ft in dia. It was lifted by a 250 ft high Goliath crane. There will be 12 s.r.u.'s in all at this English Electric-Babcock and Wilcox-Taylor Woodrow station, and the first has gone into position just over two years after a start was made on the site. It is expected that the first reactor will become critical towards the end of 1961, with the station in commission the year afterwards.

At the Hunterston station of the S of S EB, for which the GEC-Simon-Carves group are responsible, the manufacturers claim that rephasing of the construction programme has permitted work to go forward "without too much interruption." The various courses of the pressure vessel for reactor A are almost complete, ready to be lifted into position inside the biological shield and welded together. In the special fabrication shop on site, the first three s.r.u.'s for reactor A are well advanced, and work is in progress on the remaining five. A degreasing plant has been installed on site to remove the protective coating from tubes for these units. Work on reactor B at Hunterston has reached the stage where the biological shield is 134 ft high and seven of the s.r.u. plinths have been completed.

Much progress has been made with the turbine hall, where the six foundation blocks for 60 MW machines are finished. Building is in operation for a number of permanent ancillary buildings around the site. It is expected that the administration and welfare blocks will be ready for occupation by members of the permanent staff of the station early in 1961.

Hotpoint in Llandudno

A NEW extension to the Hotpoint washing machine factory at Llandudno was opened last week. This will provide additional production space to cope with the increasing demand for the company's "Countess" and "Princess" washing machines, and will bring the total labour force employed in the factory to 1,000.

A further extension costing £2 million is planned, and work is proceeding on new buildings of over 65,000 sq ft floor space to increase the total factory area to more than 230,000 sq ft, and raise the number of employees to 2,000, by the end of 1960. Production capacity will be doubled, and it is claimed that the factory will then be one of the largest appliance plants in Europe.

Because of the need for a wide road to provide adequate access to the works for vehicles, Hotpoint recently made a grant of £3,000 to the Borough of Conway towards the cost of road improvement.

£2¾ million spent on Manweb development

DURING the six months from April to September, 1959, £2,700,000 was spent by the Merseyside and North Wales Electricity Board on the development of the power distribution network. This sum included £1·4 million (including £400,000 for rural electrification) spent on extensions and £1·3 million on reinforcements and standardisation.

These figures were given at a meeting of the Merseyside and North Wales Area Consultative Council at Chester last week. Some 303 miles of overhead lines were erected during the six months, the report continued. In addition 146 miles of mains were laid underground and nearly 14,900 services were installed. Supplies to 2,718 consumers were changed from d.c. to a.c., and supplies to 1,959 consumers were standardised to 240 V a.c.

Schemes were sanctioned for developments estimated at £3,170,000. Sales of electricity during the six months totalled 2,572 million units, an increase of 7% over the same period of 1958.

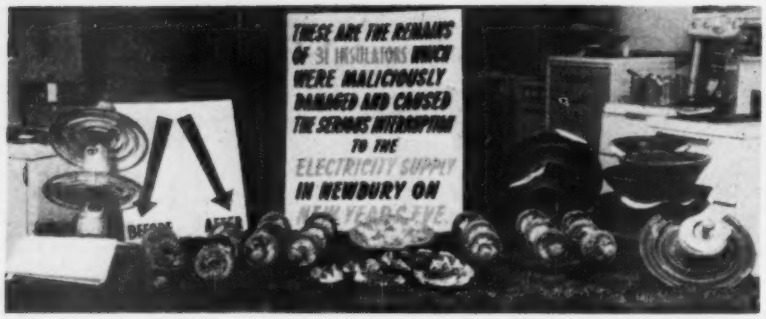
OFFICIAL PUBLICATIONS

BS 2776. Paper-covered copper conductors. Part 1, Round Wire. 6s.

REYROLLE SWITCHGEAR CONTRACTS

A CONTRACT for the first 275 kV switchgear installation in Scotland has been awarded to A. Reyrolle and Co. Ltd., by the South of Scotland Electricity Board. The installation is for a new substation sited near Strathaven, the first to be provided for the supergrid which will link the main generating stations and load centres. The station is to be commissioned early in 1962 to provide electricity supplies to the new strip mills of Colvilles Ltd.

A further contract for the 132 kV switchgear required at Richborough power station has also been placed with Reyrolle by the CEGB. As the station is only two miles from the sea, near Sandwich on the Kent coast, the switchgear is being housed in a building.



This striking display in the Newbury showroom of the SEB features 31 high-voltage insulators from two 33 kV overhead lines from Thatcham substation which were maliciously damaged by rifle fire on New Year's Eve. The resultant breakdown blacked out the area and almost caused the town to be flooded by sewage water. The supply failed at 7.20 p.m., but power was restored to most of the town by 11.20 p.m., in time for New Year festivities

F.B.I. reply to price cuts appeal

REPLYING to the Chancellor of the Exchequer's recent appeal for increased productivity to be reflected in lower prices, the Federation of British Industries has told the Government that manufacturers cannot cut prices alone. "Nationalised industries, private manufacturing industry, distributors and trade unions have, together with the Government, a responsibility for, and should each make an effective contribution to, stability of prices."

These views are contained in a letter to Mr Heathcoat Amory, Chancellor of the Exchequer, from Mr W. H. McFadzean, president of the FBI. It has been approved by the FBI Grand Council.

Mr McFadzean points out that manufactured goods account for a part only of the index of retail prices. Manufacturers' costs are not wholly within their own control, and the proportion they can control varies greatly between companies.

"Part of the proceeds of the sales of products must be reserved for research and development of techniques and markets at home and abroad," the letter goes on. "Indeed, unless some part of the margin between costs and selling prices is ploughed back in a company, improvement of its business and the growth of the country's prosperity will be retarded."

There can be no question of freezing wages, prices or profits whether by statute or by voluntary agreement, Mr McFadzean states. The FBI appreciated that the Chancellor had never suggested this.

On the question of prices, the letter continues: "Each company must determine its prices according to its assessment of its costs, of the challenge offered by competitors at home and abroad, and of the long-term interests of its own business and of the country as a whole.

> **"Competition, whether in price, quality or service, is in most cases the greatest single factor which companies have to take into account, and it will become even more intense as discrimination against dollar and other supplies is progressively eliminated and as the EFTA comes into operation.**

"We believe that our members will wish to do everything in their power to help to maintain a generally stable level of prices. We are encouraged in this by the number of manufacturers who have reduced prices recently, and by the probably greater number who have held prices stable in spite of increased costs, or have improved quality with no change in price."

English Telephone Expansion

SOON to move their head office and showrooms to new West End premises, the English Telephone Co. Ltd. originally formed in late 1954 under the chairmanship of Sir Leslie Nicholls (formerly of Cable and Wireless) are continuing their expansion programme with an increase in capital to £100,000. The company manufacture and supply under their own name every type of communications, and time and sound systems, including, under a recent licence, imported equipment and parts made by Siemens and Halske of Munich.

Industrial lighting conference

A ONE-DAY conference on Industrial Lighting will be held at the Sun Hotel, Chatham, on 27 Jan., commencing at 10.45 a.m. Arranged by the British Lighting Council, and intended for works engineers and those concerned with the installation of lighting for factories, the conference will deal with recent developments in industrial lighting practice.

Lectures include: *Good Lighting and Its Justification*, by A. Wilcock; *Maintenance and Economics*, by G. V. McNeill; *Lamps and Related Equipment*, by A. D. S. Atkinson; and *Process Lighting*, by W. H. Hodgson. There will also be a film entitled *New Light on Industry*. The registration fee of 5s includes refreshments and literature.

The BLC have also arranged a lecture on *Shop Lighting* at Oxford, intended for electrical contractors, wholesalers and the SEB. Date and venue are 25 Jan. at the SEB service centre, 37 George St. Oxford, commencing 6.30 p.m. The lecturer is Mr J. F. Roper.

Inquiries regarding the conference or the lecture should be sent to BLC at Bretenham Hse, 16-18 Lancaster Pl, W.C.2.

Sir Harold Bishop sued for libel

DAMAGES for alleged libel and slander are being claimed against Sir Harold Bishop, 59 year old director of engineering at the BBC, by Mr L. J. Peerless, 55 year old former member of the BBC's engineering division, in a five-day action to be heard by a High Court jury at Queen's Bench. At the time of the alleged libel Mr Peerless, who was with the BBC from 1929 to 1956, was a progress engineer in Sir Harold's department.

Sir Harold has been director of engineering since 1952, and was one of the pioneers of broadcasting as far back as 1923, in the days of 2LO.

VERSATILE PRODUCTIVE POWER

INDUSTRIAL portable electric tools, usually associated with and employed solely for, maintenance work, have an equally large but often unsuspected potential for productive use. Just how wide is that potential can be seen from a new industrial colour film *One Jump Ahead* launched last week by Wolf Electric Tools Ltd.

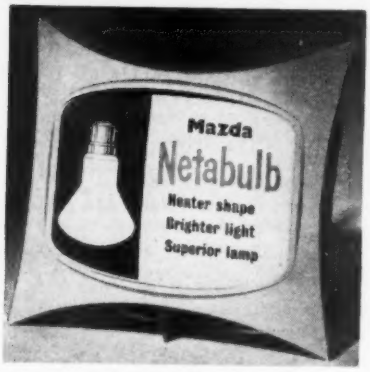
The leading role is played by BBC personality Raymond Baxter, through whose eyes the film depicts widely differing uses for portable tools in four different factories. It shows the adaptability, reliability and high performance of these tools; particularly impressive was the way in which it showed that use on precision work in machine tool fabrication.

The film is to be shown at engineering centres throughout the country and, as copies become available, will be supplied on loan, free of charge, to training organisation and technical colleges. Copies will later be available through industrial film libraries and in English-speaking countries overseas.

A scene from the film "One Jump Ahead" showing heavy duty drilling in progress using a Wolf drill

"NETABULB" PROMOTION

A TEN-WEEK advertising campaign, embracing television, the provincial Press, women's magazines and the *Radio Times*, is to be launched at the end of this month to promote AEI's Mazda "Netabulb" lamp, from 25 Jan. to 9 April.



This "Netabulb" showcard is available free to dealers

More than 40,000 retailers are being circularised with full details of the campaign. Showcards, literature and a free window dressing service are available to them, plus a "give-away" booklet.

PRESTCOLD H.P. FIRM

AS from next March, hire purchase agreements for Prestcold refrigerators are to be financed by a new company named Prestcold Finance Ltd. The company, which is privately owned with an initial authorised capital of £200,000, has been formed by the Pressed Steel Co. Ltd., manufacturers of Prestcold refrigerators, in conjunction with J. Henry Schroder and Co. Ltd., merchant bankers.

Sayings OF THE WEEK

"People nowadays who are anxious to take goods on hire purchase are not worried with the resulting cost of the transaction. They are worried as to the amount of the weekly payments." . . . MR JUSTICE E. OULD, in Sheffield County Court.

"I commend to our Government the urgent need to adopt a vigorous policy of backing British industry in its efforts overseas so that we may meet our competitors on more equal terms." . . . SIR THOMAS SOPWITH, chairman, Hawker-Siddeley group.

"The principle should be accepted by all concerned that the fruits of higher productivity can be shared when they are achieved, and not before." . . . MR W. H. MCFADZEAN, president of the FBI, writing to the Chancellor of the Exchequer.

PRICES of cable metals and other materials

Figures quoted are the official prices ruling on Tuesday, January 19

	£ per ton	Weekly change £
COPPER, standard class A (settlement)	257	−½
,, (3 months)	246	−½
LEAD, refined pig, 99·97% purity (cash)	74½	−¼
,, (3 months)	74¼	−¼
TIN, refined, min. 99·75% purity (settlement)	794	+4
(3 months)	789½	+2½
ALUMINIUM, ingots 99-99·5%	186	—
,, wire bars 99% purity	209	—
BRASS Strip 63/37	222½	+1½
SILVER (Troy oz)	80d	−¼
ZINC, virgin, min. 98% purity (cash)	94½	−1½
,, (3 months)	92	−½
RUBBER, per lb.		
No. 1, R.S.S. spot	36½d	+1½d
c.i.f. basis, ports, Mar.	33¼d	−½d
ARMOURING:		
Galv. Steel Wire (0·104 in.)	66½	—
Mild Steel Tape (0·04 × 1½ in.)	53*	—
NICKEL (home)	600	—
MERCURY (76 lb flask)	71½	—
AMERICAN PRICES:		
Copper, electrolytic (per lb)	35c	—
Lead (New York)	12c	—

* *Tape Price, now an average, includes varnishing*

National Coal Board reviews 1959

DURING 1959, the National Coal Board experienced a continuing and substantial fall in the demand for coal, in which the policy of the electricity supply industry played an important part. This is made clear in a review of the year which the board has issued. During the year, total UK consumption of coal was 190·5 million tons, which compares with total production of 206·1 million, 10·8 million of it opencast. Output was 9·7% down on 1958.

Electricity supply in 1959 took 46·1 million tons of coal, 0·1 million less than in 1958 despite a substantial (7%) increase in electricity generation. Compared with 1956 demand, this represents an increase in coal consumption of only ½ million tons; and electricity supply is the only main type of coal consumption to make any progress at all during that period. The NCB estimates that the oil conversion programme in power stations is responsible for diversion of six million tons of coal from electricity during that period.

At the end of 1959, stocks at collieries and on opencast sites totalled 36·0 million tons, compared with 19·5 million at the end of 1958. Much of this coal consists of untreated small coal.

So far as production is concerned, 1959 established new records, with overall output per man shift 26·6 cwt and faceworker production, 74·6 cwt/manshift.

The NCB estimate that consumption during 1960 will be slightly more than in 1959, at about 196 million tons.

Electrical Spending 27% up

ALTHOUGH consumer spending generally in the third quarter of 1959 was 3% up on the same period in the previous year, the increase in expenditure on electrical and radio goods rose by 27%, from £74 million to £94 million. During the first nine months of last year electrical and radio purchasing reached £274 million, an increase of 24% on the £221 million spent from January to September, 1958.

These figures are quoted in the Monthly Digest of Statistics for December issued last week by the Central Statistical Office.

Record Christmas Trade

RETAIL trade in Dec., 1959, rose to a record level at 4% above the value of spending in Dec., 1958, reports the Board of Trade. Retail prices were slightly lower than a year earlier, so that the increase is attributed to a larger volume of sales. Retail trade for the year 1959 as a whole is also estimated to be 4% up on the year before, reaching an index figure of 107 as compared with 103 for 1958.

Northfleet on Load

THE first of six 120 MW generating sets at the new Northfleet power station, Kent, went on load last Thursday night. It is a GEC reheat machine, the associated boiler being made by Foster Wheeler Ltd.

News in Brief

The new 186 mile (o.h.) radio communications link between the US and the Bahamas began operating last week end. Equipment for the Nassau terminal was made by Standard Telephones and Cables Ltd.

Pye Ltd. are negotiating for about 50,000 sq ft of factory buildings in Sheerness Dockyard.

An exhibiton of British scientific instruments is to be held in Moscow from 16 to 26 June, 1960.

The CEGB has offered to pay £400 a year for five years to support research at Brunel College of Technology, Acton, on power system controls.

A reorganisation of the Motors Division of Westool Ltd., St. Helen's Auckland, Co. Durham, has just been completed and the Design Section has been considerably enlarged.

Company Activities

IT was last April that Lord Chandos gave his opinion, reported here, that the tendency in the electrical industry will be towards larger and larger units and to organisations which would cover the whole electrical field rather than some portion of it. We saw this merging to a marked degree during 1959 in the cable industry but not until last week did we witness in so short a space and so intensely the manifestation of this forecast.

Electric and Musical Industries' counter-bid and Metal Industries' latest offer for the Ordinary and Preference capital of Lancashire Dynamo Holdings has been one of the biggest items of company news. The Metal Industries board made it known that they first approached Lancashire Dynamo more than 18 months ago. On Tuesday they raised their Christmas Eve bid by 33⅓% with an offer which LD shareholders will find very attractive. True, the board of EMI have stressed the exciting prospects offered by a merger with that group with its vast electronic resources, and have made it clear that they are now looking for industrial applications for their electronics "know-how."

On the other hand, Metal Industries, which already have control and switchgear interests, consider that the machinery side of the Lancashire Dynamo business would prove a valuable link.

Announcing the new offer on Tuesday (reported on page 111), Mr John Black, deputy chairman of Metal Industries, pointed out that it "allows the Lancashire Dynamo shareholders to receive in cash almost the value of his holdings before any offer was made and at the same time to retain a valuable interest in the combined Lancashire Dynamo—Metal Industries business on which he will receive a substantial income with good prospects."

It has also emerged that EMI had been discussing in general terms the possibilities of co-operation or amalgamation with the Lancashire Dynamo board for over a year.

The latest offer by Metal Industries is worth around £12 million, and Ordinary shareholders are offered two methods of exchange, both with a cash payment.

Whether Electric and Musical Industries' board can raise their own bid still further remains to be seen, but obviously LD shareholders will wait awhile to see if any other movement is forthcoming.

Meanwhile, most of them should be happy at seeing the value of their holdings climb from about 55s 6d when I last recommended them in June, to the current figure of about 78s.

Mr Black considers that the latest MI offer holds out considerably greater income prospects than the EMI offer.

News that plans are being drawn up for the merger of the "twins" A. Reyrolle and C. A. Parsons pushed the former's £1 Ordinary shares first 9s higher to £102 6d and then to 105s, but the latter's £1 Ordinary, initially 2s higher, slipped back to 56s. Although A. Reyrolle, the electrical engineers and a member of the Nuclear Power Plant Co., already owns 40% of the C. A. Parson's Equity, the two boards state that this does not make a closer association an easy matter because it produces technical legal difficulties. They are, therefore, to propose a scheme under which a holding company would be set up to take over the share capital of both companies although both would continue to trade as separate entities with their own management and with their present works.

"The integration proposed will strengthen the existing commercial and technical collaboration, and take advantage to the fullest extent of the diversity of the products of the two companies. It will also provide the advantages and economies of a unified organisation."

Thus state Mr H. H. Mullens and Mr F. W. Gardner, chairmen of A. Reyrolle and C. A. Parsons respectively. But it also sounds very much like Lord Chandos, AEI.—*From our City Correspondent.*

British Industrial Plastics Ltd.

With the group profit for the year to 30 Sept. last increasing to £1,113,026 (as against £979,129), the dividend is raised 2½% to a total of 22½%, with a final of 15%. It is also proposed to capitalise £1,476,812 of reserves in a one-for-one scrip issue.

Electrical and Industrial Development Trust

One million units in this Trust are being offered at a price of 13s 7½d each, or at the manager's selling price when applications are received, whichever is the lower. The commencing gross yield is calculated at £3 18s 6d per cent. The Trust holds shares in 119 companies 18 of which are in electronics, automatic and atomic energy.

Hawker Siddeley Group

In his review of the activities of the group, at the annual general meeting last week, Sir Thomas Sopwith, chairman, stated that new research centres have been built, or are under construction, in connection with diesel engines, electrical engineering, steam and industrial gas turbines, nuclear power and electronics. In the industrial group, further substantial orders have been received for transformers. Switchgear and Rotating Machines Divisions continue to expand and the latter added to its range of marine equipment by the acquisition of the Rotating Machines Division of Veritys. Fuller Electric had a successful year and established another record in the size and rating of equipment produced. The company is developing new design and manufacturing techniques for higher voltages and has extended its range of tapchanger equipment.

R. B. Pullin and Co. Ltd.

The group profit for the year to 30 Sept. last increased to £316,990, from the previous year's figure of £271,501. The final dividend is again 20%, on the increased capital, making the total 25%.

John Summers and Sons

This steel company which has a long affiliation with the electrical industry, is expected to complete its present expansion scheme this year. But Mr R. F. Summers, the chairman, does not anticipate much in the way of increased production during the first half of the year, as the task of transferring and modifying much of the finishing equipment has to be done first. But by the end of the year the productive capacity at Shotton should be approaching its target. He reports a full order book, with all departments well occupied.

Vactric Ltd.

Announcing an increase in the interim dividend from the equivalent of 11¼% to 15% on the increased capital, it is stated that group profits for the half year to 26 Sept. last amount to £224,000, compared with £230,000 for the corresponding period of the previous year.

Venner Ltd.

For the seven months ended 31 July last, the profit amounts to £63,660, compared with £82,298 for the previous 12 months. Dividend is 7%, equivalent to 12% for a year.

Westinghouse Brake and Signal Co.

Group trading profits for the year ended 3 Oct. last jumped sharply to £2,557,488. The previous year's figure was £2,035,101. This time depreciation charge is £808,935 (*£669,608*). Dividend is raised 1% to 11%. Changes have been made in the group's reserves. That against initial allowances has been reconstituted as a reserve against tax deferred by capital allowances. As a result £91,500 is transferred to revenue reserves which also gets £58,000 from tax provisions no longer required.

Intended Dividends

Cables Investment Trust. Dividend 4⅛% (*same*).

Calcutta Electric Supply Corpn. Interim 3½% tax free.

James Scott (*Electrical Engineers*). Interim 5% on larger capital, compared with the equivalent of 4·54%.

Ultra Electric (*Holdings*). Interim 7½% (*5%*).

COMMERCIAL INFORMATION

Contracts Open at Home . . .

Dates given are the final for receipt of tenders unless otherwise stated.

21 Jan.—Neath B.C. Electrical work in alterations to swimming pool in Dyfed Rd comprising annexe buildings, filtration room, plant rooms, restaurant. Applications to Town Clerk, D. King Davies, Town Hall, Neath, by above date.

22 Jan.—Melrose. Maintenance of electrical installations and equipment. Applications to Group Secretary and Treasurer, Borders Hospitals Board of Management, Newstead, Melrose, by above date.

23 Jan.—Cardiff. Supply of cables, conduit and conduit fittings to Hospital Management Committee for year from 1 April, 1960.—See 14 Jan. issue.

23 Jan.—Nottingham T.C. Supply of, item 2, lamps for E.C.—See 14 Jan. issue.

25 Jan.—Enfield B.C. Contract A: supply of 237 140 W integral jacketed sodium vapour lamps complete with control gear and lamps plus five 60 W units. Contract B: supply of 237 25 ft prestressed or reinforced concrete columns and brackets plus five 15 ft columns. Contract C: erection of columns, brackets and lanterns plus removal of steel and c.i. columns. Borough Engineer and Surveyor, H. D. Peake, 7 Little Park Gdns, Enfield. Deposit £2.

25 Jan.—Glamorgan C.C. Supply, erection and putting into service of eight 140 W sodium lighting units on A48 roundabout at Culverhouse Cross.—See 14 Jan. issue.

25 Jan.—Huddersfield T.C. Supply of (item 17) tungsten lamps; (18) m.v. and sodium lamps; (19) cables.—See 14 Jan. issue.

25 Jan.—Manchester T.C. Installation of 6·6 kV cables, road lighting and telephone cables at Davyhulme Sewage Wks extensions, stage 1B.—Advertised 7 Jan. issue. Electrical installations in 48 dwellings at Levenshulme (Contract 265) and two surgeries, Ridgway St (Contract 222F).—Advertised 14 Jan. issue. Supply of (Schedule A) carbon brushes, etc., o/h equipment.—See 14 Jan. issue.

25 Jan. — Staffordshire C.C. Provision of linear sodium street lighting on A5, Fazeley Roundabout.—See 14 Jan. issue.

25 Jan.—Wembley B.C. Supply of lamps, item 9, on supplies list.—See 7 Jan. issue.

26 Jan.—Blackburn T.C. Maintenance of school meals canteen equipment (item 2b) electric and (item 2c) refrigerators for year from 1 April, 1960.—See 7 Jan. issue.

26 Jan.—Burnley B.C. Supply of electrical equipment for Hameldon Hse hostel. Social Services Officer, 50 Manchester Road, Burnley.

26 Jan.—Egham U.D.C. Supply and erection of 712 Group "B" lanterns, fittings, prestressed concrete and timber columns, brackets, etc.—See 14 Jan. issue.

27 Jan.—Amesbury P.C. Supply and erection of 63 140 W sodium lamps along A303. Clerk of the Council, 52 Countess Rd, Amesbury.

27 Jan.—Durham C.C. (a) Electrical installation in Billingham new day school: (b) in additions and alterations in Houghton-le-Spring Modern School: (c) in additional accommodation at Ryhope Modern School; renewal of electrical installation at Wheatley Hill County School. Applications to County Architect, South St, Durham, by above date.

27 Jan.—Kingston upon Hull T.C. Electrical installations in (a) 92 dwellings on land north of Boothferry Rd and (b) 26 dwellings, Springhead Ave, for City Architect's Dept. Deposit £2 to City Treasurer.

28 Jan.—Down C.E.C. Lighting installations at Moneyrea new primary school. Details from consulting engineer, W. J. Ogle, 63 Main St, Bangor, Co. Down. Deposit £3 3s.

28 Jan.—Gainsborough U.D.C. Conversion of hand-operated service lift to electric drive in Town Hall.—See 7 Jan. issue.

28 Jan. — Gt. Yarmouth T.C. Electrical installation in new H.Q., police station, at Howard St South.—See 24 Dec. issue.

28 Jan.—Luton B.C. Erection and wiring only of 440 Class "B" concrete lighting columns with sodium discharge lighting.—See 7 Jan. issue.

28 Jan.—St. Albans and Watford R.D.C's. Provision of street lighting on North Orbital Rd, A405. Applications to Engineers, at 43 Upper Lattimore Rd, St. Albans, and Wynyard Hse, Langley Rd, Watford, by above date.—Advertised in this issue.

29 Jan.—Cardiff T.C. Electrical installation in extension to Glantaf County Secondary Mixed School, Llanduff North. City Surveyor, City Hall, Cardiff. Deposit £2 2s.

29 Jan.—Churchdown P.C. (1) Supply of 94 140 W sodium aero-screened lanterns with ancillary equipment: (2) supply and erection of 94 steel columns together with fitting and wiring of tenderer's own lighting equipment: (3) as (2) but for fitting and wiring of equipment offered by another firm.—Advertised 31 Dec. issue.

29 Jan.—Doncaster T.C. Supply of (item 13) lamps for year to 31 March, 1961.—See 14 Jan. issue.

29 Jan.—Great Yarmouth T.C. Supply of cables for year from 1 April, 1960.—Advertised 14 Jan. issue.

29 Jan. — Manchester T.C. Contract 324, supply and installation of two passenger lifts in nine-storey block of flats at Kingsgate Rd, Wythenshawe.—See 14 Jan. issue.

29 Jan.—Renfrew C.C. Supply and erection of: (A) sodium vapour lighting with minimum output of 20,000 lumens on 35 ft steel columns with a 9 ft outreach; Stage 1—41 units Glasgow boundary to Eastwood Toll; Stage 2—204 units Eastwood Toll to Malletsheugh Inn. (B) 140 W sodium vapour lighting on 25 ft steel columns with a 4 ft outreach; Stage 1—45 units Rouken Glen Rd, Giffnock and Thornliebank; Stage 2—44 units Speirsbridge Rd, Main St, Thornliebank.—See 14 Jan. issue.

30 Jan.—Batley B.C. Supply of Class "A" lighting equipment: 140 W sodium lamps/jackets, lanterns and control gear, 25 ft concrete columns with brackets, solar dial time switches and 3/·029 twin and earth cable. Borough Surveyor, Hanover St, Batley.

30 Jan.—Bermondsey B.C. Supply of lamps for year.—See 14 Jan. issue.

30 Jan.—Fife C.C. Supply of 32 steel columns, sodium lanterns, etc., for Group "A" roundabout lighting.—See 14 Jan. issue.

30 Jan.—Gloucestershire C.C. Supply of lamps for year from 1 April, 1960, to Welfare Committee.—See 14 Jan. issue.

30 Jan.—Horbury U.D.C. Supply of (item 2) 240 V street lighting lamps for year to 31 March, 1961.—See 14 Jan. issue.

30 Jan.—Ross and Cromarty C.C. (g) Electrical work in (1) two two-apartment, four three-apartment and two five-apartment houses at Kyle of Lochalsh; (2) 11 three-apartment and six four-apartment houses at Maryburgh. Applications to quantity surveyors: R. Armour and Partners, 375 Union St, Aberdeen, by above date.

30 Jan.—Runcorn U.D.C. Supply of (item 15) lamps for year.—See 14 Jan. issue.

30 Jan.—Sutherland C.C. Electrical work in erection of eight houses at Sibell Rd, Golspie. Applications to County Architect, E. W. Brannen, Dornoch, by above date.

30 Jan.—Stockport T.C. Supply of street lighting equipment (item 13) lamps; (14) lanterns, chokes, capacitors and time switches.—See 14 Jan. issue.

1 Feb.—Caerphilly U.D.C. Supply of (item 15) lamps and (item 16) road lighting electrical equipment. Omnibus Manager, Omnibus Garage, Mill Rd, Caerphilly.

1 Feb.—Chadderton U.D.C. Supply of lamps (item 4) and reinforced concrete columns (item 8). Applications to Engineer and Surveyor, Town Hall, Chadderton, enclosing foolscap s.a.e.

1 Feb.—Chester T.C. Supply of bulbs for year.—See 14 Jan. issue.

1 Feb.—Glastonbury B.C. Supply and erection of pumps, motors, control gear, pipework and valves at Wells Rd sewage pumping station.—See 14 Jan. issue.

1 Feb.—Hemel Hempstead B.C. Supply of item 21 lamps for year. Borough Engineer, A. H. Turner, High Street, Hemel Hempstead.

1 Feb.—N. Ireland. Electrical installation in new office building, Queen Elizabeth Rd, Enniskillen.—See 14 Jan. issue.

1 Feb.—N. Ireland. Supply of (item 15) lamps, cable and conduit for year from 1 April, 1960. Secretary, Downpatrick Hos-

Your Queries Answered

Readers are invited to make use of our free enquiry department which possesses wide resources, including an index of trade information with over 100,000 entries

A Selection from the 112 queries answered this week

J. Edward Hall (Electrical Engineers) Ltd.—Midlands address for? T.B.C.—The Tower, 140 Raby St, Manchester 4.

"Termate" terminal blocks—makers of? M.C.C.—Termination Equipment Ltd., Noel Wks, Elson St, Basford, Nottingham.

"Walligraph" extensible desk lamp—makers of? D.O.A.—Walter Grafton and Son Ltd., 122 Foots Cray Rd, S.E.9.

Easiwork Ltd.—address for? S.E.—Beechings Way, Gillingham, Kent.

"Wima" capacitors—agents for? E.T.—Wavcom Ltd., Empire Bldgs, Duke St Hill, S.E.1.

"Davenset" rectifiers — makers of? U.A.S.—Partridge, Wilson and Co. Ltd., Davenset Electrical Wks, Evington Valley Rd, Leicester.

"M. and R." lanterns—makers of? M.F.—Marrison and Revell Ltd., 4 Ridgeley Mews, N.W.10.

"Elmatic" elements — makers of? L.E.B.—Elmatic Ltd., Colchester Estate, Colchester Ave, Cardiff.

ANSWER WANTED

"Oxford" R.T.110 arc welding set—makers of? W.C.L.

pital Management Committee, Downshire Hospital, Downpatrick.

1 Feb.—Stoke-on-Trent T.C. Supply of (item S) lamps for year to 31 March, 1961. Engineer and Surveyor, Town Hall, Stoke-on-Trent.

2 Feb.—Dublin T.C. Supply of 112 enclosed bowl type street lighting fittings. Engineer and Town Planning Dept., 28/9 Castle St, Dublin.

3 Feb.—Friern Barnet U.D.C. Supply of street lamps for year from 1 April, 1960.—Advertised 14 Jan. issue.

3 Feb.—Machrihanish. Electrical work in connection with runway extension, etc., including: (a) lighting installation including runway and approach systems; (b) h.v. and m.v. cable installations extensions; (c) connecting of cables, switchgear, transformers, etc., in substations and lighting in substations and control building. N.A.T.O. Common Infrastructure Contract Slices VII and VIII, value £105,000.—See 7 Jan. issue.

3 Feb.—Markethill. Provision of electrical services to pens at Poultry Testing Station, Gosford, Castle Estate, Co. Armagh. Details from Ministry of Finance, Room 103, Law Courts Bldg, Belfast. Deposit £2.

3 Feb.—Oakengates U.D.C. Supply, erection and installation of 108 Group "B" 60 W sodium lighting units on concrete columns on various roads. Engineer and Surveyor, Council Offices, Stafford Rd, Oakengates. Deposit £2 3s.

3 Feb.—Southwark B.C. Supply of (item 8) lamps.—See 14 Jan. issue.

4 Feb.—Saddleworth U.D.C. Installation of 10 lighting points on concrete columns at Browhill housing estate, Austerlands. Lighting Superintendent, Council Offices, Uppermill, nr. Aldham.

5 Feb.—Brentwood U.D.C. Supply of (item 22) bulbs.—See 14 Jan. issue.

5 Feb.—Bridlington B.C. Supply and installation of two sets of duplicate pumping plant, 25,000 and 35,000 g.p.h., automatically controlled. Water Engineer and Manager, 11 Marton Road, Bridlington. Deposit £2 2s.

5 Feb.—Omagh. Electrical installation in 360-pupil voluntary intermediate school for girls. Details from Varming and Mulahay, 37 Malone Rd, Belfast 9.

5 Feb.—West Suffolk C.C. Supply and erection of 14 35 ft steel columns and 200 W linear sodium discharge lamps in cut-off lanterns on A11 Barton Mills Roundabout. County Surveyor, Manor Hse, Bury St. Edmunds.

6 Feb.—Barry B.C. Supply of (I) electrical goods including vehicle batteries for year from 1 April, 1960.—See 14 Jan. issue.

6 Feb.—Newbury B.C. Supply and installation of three vertical spindle suspended axial flow propeller pumps each capable of 2,014 g.p.m. for sewage effluent pumping station.—Advertised 14 Jan. issue.

6 Feb.—Warrington R.D.C. Supply and erection of 55 Class "B" sodium vapour units on Green, Holes and Cinnamon, Lancs, at Poulton-with-Fearnhead. Engineer and Surveyor, Council Offices, Museum St, Warrington.

6 Feb.—Worsley U.D.C. Supply of tungsten and sodium discharge lamps for year ending 1 April, 1960. Applications to Clerk and Solicitor, R. E. Huband, Worsley, enclosing foolscap s.a.e.

8 Feb.—Brighouse B.C. Supply of mercury discharge and tungsten lamps.—See 14 Jan. issue.

8 Feb.—East Devon. Supply and installation of a small hydro-pneumatic booster plant in Pinhay Development scheme. Contract P5 (amended). Engineer, East Devon Water Board, 46 New St, Honiton.

8 Feb.—Kirkcaldy T.C. Supply and installation of 300 cookers and 300 washboilers.—See 14 Jan. issue.

8 Feb.—N. Ireland. Main connections between generator and associated transformer for No. 3 60 MW turbo-generator at Coolkeeragh.—See 14 Jan. issue.

8 Feb.—Rochdale T.C. Lighting and power installations at Greenbank Junior School. Borough Surveyor, Town Hall, Rochdale.

9 Feb.—Hebburn U.D.C. (2) Electrical installations in 24 flats and maisonnettes in Station Rd. Engineer and Surveyor, Council Offices, Argyle St, Hebburn. Deposit £3 3s.

10 Feb.—Lanarkshire. Electrical work in new fire station at Shotts for Fire Brigade Joint Committee. Details from architects: Gavin Paterson and Son, 6 Cadzow St, Hamilton.

10 Feb.—Lancaster T.C. Supply and installation of: (1) three low lift pumps (two of which working together to deal with 3,050 g.p.m. and 4,500 g.p.m.); (2) three high lift pumps (two of which for 2,778 and 4,167 g.p.m.), for River Lune Scheme.—Advertised 7 Jan. issue.

10 Feb.—Solihull B.C. Supply of (item 7) fittings and (item 8) lamps for year from 1 April, 1960. Borough Surveyor, 90 Station Rd, Solihull.

11 Feb.—Widnes B.C. Supply of electrical equipment (item 7) and (item 8) lamps for year to 31 March, 1961. Borough Engineer and Surveyor, F. A. J. Knight, Town Hall, Widnes.

12 Feb.—Alfreton U.D.C. Installation of 113 140 W sodium and five 3/80 W fluorescent lanterns plus 118 concrete columns for Leabrooks lighting. Engineer and Surveyor, Council Offices, Nottingham Road, Alfreton, Derbys. Deposit £2 2s.

12 Feb.—Harrogate B.C. Supply of (item 13) lamps for year to 31 March, 1961. Borough Engineer, C. E. Fellows, Municipal Offices, Harrogate.

12 Feb.—Leeds T.C. (a) Supply and installation of 1,000 g.p.m., 200 ft manemetric head pumping equipment. City Engineer, Civic Hall, Leeds 1. Deposit £2 2s.

13 Feb.—Birkenhead B.C. Supply of electrical equipment for motor bus and ferry sections. General Manager, Transport Dept., Laird St, Birkenhead.

13 Feb.—Consett U.D.C. Supply of street lighting lamps for year to 31 March, 1961. Surveyor's Dept., Council Offices, Medomsley Rd, Consett.

13 Feb.—Grimsby B.C. (c) Electrical installations, on fixed-price basis, in remodelling of Edward Primary Infants' School, Edward St.—See 14 Jan. issue.

13 Feb.—Grimsby B.C. (c) Electrical installation on fixed-price basis in new science block at Havelock Secondary School, Holyoake Rd, off Carr La; in Grantham Ave Primary Junior School, off Edge Ave, Scartho. Borough Engineer and Surveyor, Municipal Offices, Town Hall Sq, Grimsby. Deposit £5 each contract.

13 Feb.—Lurgan B.C. Supply of (item m) electrical stores for year from 1 April, 1960. Borough Surveyor's Office, 6 Union St, Lurgan.

17 Feb.—High Wycombe B.C. (1) Supply and erection of steel columns and installation of lanterns, auxiliary equipment, wiring, etc.; (2) supply of 250 W mercury discharge lamps, lanterns and auxiliary equipment. Borough Engineer's Office, Municipal Offices, High Wycombe.—Advertised in this issue.

20 Feb.—Merthyr Tydfil B.C. Supply of (item 8) electrical goods for year from 1 April, 1960. Engineer and Surveyor, Town Hall, Merthyr Tydfil, Glam.

4 March—Notts C.C. Supply and erection of columns, lanterns and switchgear on traffic island on A614. County Surveyor, Shire Hall, Nottingham. Deposit £2.—Advertised in this issue.

No date stated—Swinton B.C. Electrical installation in 16 flats.—See 14 Jan. issue.

TRADE NOTES

Change of Address. Rhoden Partners Ltd. have moved to 19 Fitzroy Sq, W.1. Telephone Euston 9696.

The Glasgow and Manchester office addresses of Bruce Peebles & Co. Ltd. have been changed. They are now: Carlton Hse, 26 Blythswood Square, Glasgow, C.2. Telephone: Central 6677, and Peter Hse, St. Peter's Sq, Manchester 1. Telephone Central 6690.

The main sales engineering and contracts departments of Lee Guinness have been moved from the company's H.Q. and factories in Northern Ireland to a newly opened office at 25 Victoria St, S.W.1 (Tel. Abbey 6762). In charge of these departments is Mr. J. B. Souter, under the direction of Mr. J. E. Bishop, general manager, who is responsible for the company's activities in London.

Battery Distribution. Dagenite aircraft batteries, which have previously been distributed by Peto and Radford, will be marketed by the manufacturers, Pritchett and Gold and E.P.S. Co. Ltd., 137 Victoria St, S.W.1, who are the proprietors of Peto and Radford.

Change of Name. All commitments and warranties entered into by the Visual Aids Division of Chadwick-Latz Ltd. have been taken over by Visual Marketing Services Ltd., 6-8 Ludgate Hill, E.C.4.

New Telephone Number. The telephone number of Croxton and Garry Ltd. has been changed to Kingston 9444.

Representatives. Photo electronics (M.O.M.) Ltd. have appointed Paton Bros. Engineering Services, as their representatives for Yorkshire, Lancashire and Cheshire.

Agency. R. H. Cole (Overseas) Ltd., 2 Caxton St, S.W.1, have been appointed sole U.K. importers and distributors for communications test-gear made by Siemens and Halske.

Beama Contract Price Adjustment Formulae. *For Electrical Machinery and Equipment.* For purposes of calculating variations in (*a*) "Rates of Pay"—the rate of pay for adult male labour at 15 Jan., 1960, shall be deemed to be 196s; (*b*) "Cost of Material"—the index figure for materials used in the Electrical Machinery Industry at 15 Jan., 1960, is 116·3* (180·4*).

For Turbo-Generating and Allied Plant. For purposes of calculating variations in: (*a*) "Rates of Pay"—the rate of pay for adult male labour at 15 Jan., 1960, shall be deemed to be 196s. (*b*) "Cost of Material"—the index—figures at 15 Jan., 1960, are: Materials used in Mechanical Engineering Industries, 125·4* (188·4*). "Blast Furnaces and Iron and Steel Melting and Rolling (1948 S.I.C. ref. 40/41)" 189. Other Steel Goods, excluding tubes (1958 S.I.C. ref. 311/2), 128·8. The price of brass condenser tubes ½ in. o/d 18 s.w.g. on 15 Jan., 1960, is 4s 11d per lb. *Provisional figure.

The figures in parentheses shown above relate to the earliest list of wholesale price index numbers in which the year 1949 is taken as the base 100. For the other figures 1954=100.

Jordan's Imports. Under changes in Jordan's customs tariff, electro-mechanical domestic appliances with self-contained electric motors the rate of duty is increased from 15% to 20% *ad valorem.*

. . . and Overseas

*Details of items marked * may be obtained on application to the Board of Trade, Lacon Hse, Theobalds Rd, W.C.1, quoting reference.*

10 Feb.—Nigeria. 36 150 MVA 6·6 kV extensible pattern ring main units. Secretary, Electricity Corporation of Nigeria, H.Q., 13 Broad St, Lagos. B.o.T. (ESB/315/60).*

17 Feb.—India. Tower and control cable for Rihand grid substations. Superintending Engineer, S. N. Singh, Rihand H-E Design Directorate, 10/489, Allengarj, Kanpur. B.o.T. (ESB/30313/59).*

20 April—Egypt. Two 60 MW turbo-alternators, four 200 tons/hr boilers, auxiliary equipment and civil work. Alternative offers for one 60 MW set and two boilers required. Cairo Electricity and Gas Administration, 26th July St No. 53, Cairo. B.o.T. (ESB/29639/59).*

BUSINESS PROSPECTS

Home

Arbroath T.C. Erection of 75 houses in 12 blocks for Seaton Rd housing scheme. Burgh Architect, 32 Hill St.

Ashington. Erection of a four-storey ward block at Ashington General Hospital, for Newcastle Hospital Board, Benfield Rd.

Bollington U.D.C. Erection of 28 bungalows at Bollington Cross. Engineer and Surveyor, Bollington, Macclesfield.

Bolsover. New 10,000 sq ft chemical research laboratory to be erected in Buttermilk La for Coalite and Chemical Products Ltd.

Bootle B.C. Work to commence soon on new shopping centre at Netherton.

Chesterfield T.C. To erect £150,000 swimming pool with restaurant and clubroom.

Colchester B.C. Erection of 75 flats and houses on Greenstead site. Borough Engineer, 1 West Stockwell St.

Croydon B.C. Erection of hostel on Ashburton housing estate. Borough Engineer.

Dagenham B.C. Alterations and extensions to provide additional laboratory and demonstration room. Borough Surveyor.

Doncaster T.C. To erect new hostel and 18 pairs of bungalows for old people in Highbury Ave, Cantley estate. Borough Architect.

Durham C.C. New schools included in the E.C.'s 1960-61 programme are: Cleadon Junior, Peterlee Shotton Hall Junior, Peterlee Shotton Hall Secondary and Annfield Plain Day Special.

Featherstone U.D.C. Erection of 22 houses at Featherstone Sq. Architects, Turner and Holland, 4 King St, Wakefield.

Flint B.C. Erection of 24 dwellings, Walwen, Bagillt. Engineer and Surveyor.

Gateshead. Tenders to be obtained by N.E. Housing Association, Windsor Ter, Newcastle upon Tyne, for the erection of 138 traditional houses on Leam La estate.

Gelligaer U.D.C. Erection of 112 dwellings in first phase of Shringrig housing scheme, Trelewis. Engineer and Surveyor, Hengoed, Glam.

Gosforth U.D.C. Erection of 30 dwellings at Coxlodge. Surveyor.

Gt. Yarmouth B.C. Erection of 52 dwellings in five groups. Borough Engineer.

Haltwhistle R.D.C. Erection of 32 "Unity" flats at Greenholme, Haltwhistle. Surveyor.

Hereford T.C. Erection of 62 houses on Newton Farm site. City Architect.

High Wycombe B.C. Erection of 19 houses at Gibson Rd. Borough Engineer.

Holywood U.D.C. Have approved amended £300,000 scheme for 103 dwellings in Hill St redevelopment area.

Isle of Ely C.C. To erect £42,000 first instalment of new grammar school, March, in 1960-61 financial year.

Jarrow B.C. Erection of 84 dwellings (Scheme 102). Borough Engineer.

Kemnston U.D.C. To erect £23,000 four-storey block of flats in Bunyan Rd.

Leicester T.C. To erect 298 Easiform houses on Eayres Monsell estate.

Manchester T.C. Erection of 65 dwellings Maple Rd, Brooklands, and shops plus flats at Greenwood Rd East. Director of Housing, Room 626, Town Hall. Alterations and extensions, Nelson St Junior and Infants' School. Miles Platting. City Architect, P.O. Box 488.

Middlesbrough T.C. E.C. to spend £1,750 on electrical installation at Beechwood Junior and Infants' School..

Mullinear. Erection of milk separating station in Green Rd. Secretary, Westmeath Co-operative Agricultural and Dairy Society, 31 Pearse St.

Newburn U.D.C. To build shops on the Mount Pleasant estate, Throckley.

Newbury B.C. Erection of 78 houses on Bath Rd estate. Borough Surveyor.

Newcastle upon Tyne. C. G. S. Buist Ltd., motor engineers, etc., St. Mary's Pl, are to erect new 60,000 sq ft showrooms, etc. at Etherstone Ave, Cochrane Pk.

North Riding C.C. Erection of a primary school at Marton-in-Cleveland. Architects, Morrison and Partners, 103 Belper Rd, Derby.

Northampton T.C. £250,000 extensions to Town Hall including shops and basement car park.

Northumberland C.C. To erect a £50,000 home for handicapped persons at Morpeth. Erection of the first stage of a primary school at Old Hartley. Construction of primary school and social centre at Kielder.

Oldbury B.C. Erection of laboratory block at Oldbury Grammar School, Moat Rd. Borough Engineer and Surveyor, Municipal Bank Chambers, Birmingham St.

Oldham B.C. Erection of 30 dwellings on Alt estate. Quantity surveyors, Cameron and Middleton, 21 Queen St.

Risca U.D.C. Erection of 32 houses and 28 flats on Channel View site, Pontymister. Engineer and Surveyor.

St. Faith's and Aylsham R.D.C. Erection of 37 bungalows on six sites. Housing Officer, Tudor Hall, Rose La, Norwich.

Stepney B.C. Erection of two connected blocks of ten maisonnettes. Borough Engineer and Surveyor, 227/233 Commercial Rd, E.1.

Taunton B.C. Erection of 22 dwellings on Lane estate. Borough Architect.

Wallsend. Commercial Plastics Ltd., Stephenson St, Wallsend, are to erect new laboratory block and factory building, and have prepared their own plans. The Eldorado Ice Cream Co. Ltd., London, have prepared plans for alterations and additions to the depot at Oak Grove.

West Hartlepool T.C. E.C.'s 1960-61 estimates include £7,000 for the rewiring of West Hartlepool Technical College.

Widnes B.C. Erection of six-classroom Greenfield (Day Special) School in Green La. Borough Architect, Grendan Hse, Widnes Rd.

Worcester T.C. Recommended to approve Howe, Lea and Partners, 23 St. James Rd, Birmingham 15, as consulting engineers for electrical installations in Christopher Whitehead Girls' Secondary School extension.

Gazette Announcements

COMPANIES ACTS

Independent Direct Supplies Ltd. Mr R. J. Steen, 341 Regent's Pk Rd, N.3, appointed liquidator as from 29 Dec.

Electric Supply Corpn. (Overseas) Ltd. Creditors to send details to liquidator, Mr K. F. Steven, 66 London Wall, E.C.2, by 1 Feb.

Bethel and Pitts (Electrical) Ltd. Meeting of creditors to be held at Board Room, Harry L. Price and Co., 47 Moseley St, Manchester 2, on 27 Jan., at 12 noon.

Electric Movement and Eng. Co. Ltd. Liquidator: R. Y. Rickard, 20 Southampton Pl, W.C.1, released as from 9 Dec.

Partnership Dissolved

Hebden Bridge. Partnership between J. T. Windle and D. P. Pawsey, suppliers of electrical goods, carrying on business as Windle and Pawsey at Commercial St, Hebden Bridge, Yorks, and 38 Ewart St, Gt. Horton, Bradford 7, dissolved as from 12 Dec. All debts to be paid by J. T. Windle.

BANKRUPTCY ACTS

Public Examinations

Cardiff. G. B. Bullen, electrician, 58 Canada Rd, Cardiff. Public examination: 10.30 a.m., 5 Feb., at County Court, Westgate St, Cardiff.

Portsmouth. E. F. Jones, trading as "Electrical Services" and lately carrying on business at 160 Shearer Rd, Portsmouth. Public examination: 10.30 a.m., 7 March, at County Court, Ashburton Rd, Kent Rd, Portsmouth.

Halifax. E. Greenwood, electrician, carrying on business at Westgate, Elland. Public examination: 10.30 a.m., 1 March, at County Court, Prescott St, Halifax.

Luton. B. F. J. Brill, electrical engineer, 64 Princess St, Luton. Public examination: 11 a.m., 3 March, at Court Hse, Stuart St, Luton.

Manchester. W. R. Woods, electrical retailer, carrying on business as Banwood Electrics, at 136 Claremont Rd, Moss Side. Public examination: 10.30 a.m., 26 Feb., at Court Hse, Quay St, Manchester.

Applications for Discharge

Kingston upon Hull. J. E. Byrne, electrical contractor, carrying on business at 3 Wells Yd, Waterworks St. Discharged as from 13 Jan.

Wandsworth. C. A. Norwood, electrical contractor, carrying on business at 38 Thornbury Rd, S.W.2. Discharged as from 18 Dec., 1959.

Appointment of Trustee

Colchester. G. G. Short, manufacturing electronics engineer, lately carrying on business at John St, Market Rasen. Mr R. A. Paterson appointed trustee as from 6 Jan.

Release of Trustee

High Court of Justice. H. P. Merken, electrical contractor, 22 Petherton Rd, N.5. Trustee: Mr A. A. Walter, Carey St, W.C.2, released as from 6 Jan.

Intended Dividend

Torquay. G. Frankis and B. W. V. Smith, lately carrying on business in co-partnership as Brixham Electric Service, at 4 The Strand, Brixham. Last day for receiving proofs: 26 Jan., to Trustee: Mr A. D. Gwyther, Royal Bldg, St. Andrew's Cross, Plymouth.

Receiving Order

Plymouth L. W. Brown, radio, television and electrical engineer, carrying on business at 18 Lower Lux St, Liskeard. Receiving order dated 12 Jan.

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

Tedelex. 783,673. Class 7. Drying machines for laundries, polishing machines, motors, etc. 783,674. Class 8. Shaving instruments. 783,676. Class 11. All goods. Television and Electrical Distributors (Pty.) Ltd., 54 Maxwell St, Ophirton, Johannesburg, S. Africa.

Surveymaster. B790,021. Class 9. Apparatus for detecting and measuring moisture. Sir John Gallwey (Instruments) Ltd., Gallwey Hse, 356/368 Evelyn St, S.E.8.

Magnastat. 792,688. Class 9. Thermostatically operated devices for automatically controlling the temperature of soldering irons, etc. Weller-Elektro-Werkzeuge G.M.B.H., Besigheim am Neckar, Germany.

Alucer. 792,898. Class 9. Articles made of, having a surface of, or reinforced by, sintered aluminium. Compagnie Generale D'Electro-ceranique, 12 rue de la Baume, Paris 8, France.

Chancellor, Diplomat, Milord and **Peerage.** 795,339/43. Class 9. Vacuum cleaning apparatus, etc. Bylock Electric Ltd., 109 South St, Enfield, Middx.

Candy. B789,757. Class 11. Refrigerators, etc. G.B.C. Electronic Industries Ltd., 121-3 Edgware Rd, W.2.

MEETINGS TO NOTE

THURSDAY, 21 JAN.

I.E.E. (N. Midlands Centre, Hull District). "Domestic Electricity," D. Hardy. Y.E.B. Offices, Ferensway, Hull. 6.30 p.m.

I.E.E. (Western Centre). Faraday Lecture, Professor M. G. Say. Sophia Gdns Pavilion, Cardiff. 6.45 p.m.

I.E.E. (S.W. Sub-Centre). "The Deltic Locomotive," C. M. Cock. Plymouth "B" Generating Station, Prince Rock, Plymouth. 3 p.m.

I.E.E. (Irish Branch). "The Place of Electricity in Irish Agriculture," J. F. Bourke and M. Shiels. Physical Laboratory, Trinity College, Dublin. 6 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS (Scottish Section). "Micro Miniaturisation," H. G. Manfield. Institution of Engineers and Shipbuilders, 39 Elmbank Cres, Glasgow. 7 p.m.

CHELMSFORD ENGINEERING SOCIETY. "Storage and Manipulation of Information in the Brain," R. L. Beurle. Social Hall, Hoffmann Mnfg. Co. 7.30 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (E. Midlands Section). "Instrument Research at Stewarts and Lloyds," M. J. Hetherington. College of Technology and Commerce, The Newarke, Leicester. 7.15 p.m.

S. WALES INSTITUTE OF ENGINEERS. Annual dinner. Park Hotel, Cardiff. 7 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Tees-side Section). "The Education of Instrument Engineers," E. J. Charnley. Cleveland Scientific and Technical Institute, Corpn. Rd, Middlesbrough. 7.30 p.m.

FRIDAY, 22 JAN.

A.S.E.E. (Stoke and Crewe Branch). "Earthing and Earth Leakage Protection of Electrical Installations," J. A. Robbins. Royal Hotel, Crewe. 7.30 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS (Scottish Section). "Micro Miniaturisation," H. G. Manfield. Dept. of Natural Philosophy, The University, Drummond St, Edinburgh. 7. p.m.

JUNIOR INSTITUTION OF ENGINEERS. "Developments in Engineering Education, Recently and to Come." Dr H. L. Haslegrave. Pepys Hse, 14 Rochester Row, S.W.1. 7 p.m.

I.E.E. (N.E. Centre). "Research on the Performance of High-Voltage Insulators in Polluted Atmospheres," J. S. Forrest, P. J. Lambeth and D. F. Oakeshott. Carlisle Technical College. 7 p.m.

MONDAY, 25 JAN.

I.E.E. (Mersey and N. Wales Centre). "The Characteristics and Protection of Semi-conductor Rectifiers," D. B. Corbyn and N. L. Potter. Town Hall, Chester. 6.30 p.m.

I.E.E. (S. Midlands Electronics and Communications Group). "Long-Distance Waveguide Communication," F. J. D. Taylor. James Watt Institute, Birmingham. 6 p.m.

I.E.E. (W. Utilisation Group). "A Review of Electric Drives for Cranes," L. J. Roberts. S.W.E.B. Demonstration Theatre, Colston Ave, Bristol. 6 p.m.

I.E.E. (London Graduate and Student Section). "Transistors in Switching Circuits," M. Paskins. Savoy Pl, W.C.2. 6.30 p.m.

A.S.E.E. (N.W. London). "Control Gear," R. F. Mathieson. Compass Hotel, Watford. 8.15 p.m.

I.E.S. (Birmingham Centre). "Domestic Lighting." D. W. Durrant. Bennett Hall, Y.M.C.A., Snow Hill, Birmingham. 6 p.m.

I.E.S. (Leeds Centre). "Some Recent Developments in Street Lighting." N. Burgess. British Lighting Council, 24 Aire St, Leeds 1. 6.15 p.m.

I.E.S. (Leicester Centre). "Recent Developments in Light Sources." D. H. Holloway. Demonstration Theatre, E.M.E.B., Charles St, Leicester.

I.E.E. (E. Anglian Sub-Centre). "Radio Interference from H.V. Insulators," C. H. W. Clark. Electric Hse. Ipswich. 6.30 p.m.

TUESDAY, 26 JAN.

I.E.E. (N.W. Supply Group). "Research on the Performance of H.V. Insulators in Polluted Atmospheres," J. S. Forrest, P. J. Lambeth and D. F. Oakeshott. Engineers' Club, Albert Sq, Manchester. 6.15 p.m.

I.E.E. (S.W. Scotland Sub-Centre). "The Relationship of Physical Mechanisms to Psychological Processes," Professor A. Tustin. Royal College of Science and Technology, George St, Glasgow C.1. 6 p.m.

A.S.E.E. (E. Kent Branch). "The Decca Navigational System," B. A. A. Smye-Rumsby. Clarendon Hotel, Broadstairs. 8 p.m.

INSTITUTION OF PLANT ENGINEERS (S. Wales Branch). "Safety in Uses of Industrial Gases and Equipment," M. T. Reeks. South Wales Engineers' Institute, Park Pl, Cardiff. 7.30 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY. Symposium on Flame Failure Detection. Manson Hse, 26 Portland Pl, W.1. 7 p.m.

MINISTRY OF WORKS. "Electric Floor-Warming," E. W. Faithfull. Beaufort Hall, Mackworth Hotel, Swansea. 7 p.m.

WEDNESDAY, 27 JAN.

I.E.E. (Electronics and Communications Section). "The Oral Presentation of Scientific Material," A. Clow. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (S.E. Scotland Sub-Centre). "The Relationship of Physical Mechanisms to Psychological Processes," Professor A. Tustin. Carlton Hotel, North Bridge, Edinburgh. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS. "Technical and Economic Aspects Covering the Ocean Transportation of Liquid Methane," Dr J. J. McMullen. 1 Birdcage Walk, S.W.1. 6 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (S. Wales Section). "The Basic Principles of Digital Instrumentation," D. S. Evans. Physics Lecture Theatre, Welsh College of Advanced Technology, Cardiff. 6.45 p.m.

I.E.E. (E. Midlands Centre). "D.C. Winder Drives using Mercury-Arc Rectifiers/Inverters," L. Abram, J. P. McBreen and J. Sherlock. College of Arts and Crafts, Waverley St, Nottingham. 6.30 p.m.

THURSDAY, 28 JAN.

I.E.E. (Ordinary Meeting). "Radio Communications by Means of Satellites," A. W. Lines. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (Southern Centre). "Nuclear Physics—The Elementary Particles," G. N. Fowler. South Dorset Technical College, Weymouth. 6.30 p.m.

A.S.E.E. (Brighton Branch). "Switchgear Testing." R. Jones. New Imperial Hotel, First Ave, Hove. 7.30 p.m.

A.S.E.E. (Southampton Branch). "Impregnating Varnishes and Wire Enamels." K. B. Smith. Polygon Hotel, Southampton. 8 p.m.

INSTITUTION OF PLANT ENGINEERS (Mersey and N. Wales Branch). "Steam Supplies from a Central Back-pressure Plant to an Integrated Group of Factories," J. B. Lancaster. Donnan Laboratories, University of Liverpool. 7 p.m.

INSTITUTION OF PLANT ENGINEERS (Sheffield Branch). "Instrumentation," Dr R. H. Baulk. Grand Hotel, Sheffield. 7.30 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Cheltenham Section). "Photographic Aids to Industry," P. H. Herbert. Belle Vue Hotel, Cheltenham. 7.30 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Chester Section). "The Application of Method Study to Instrument Maintenance," D. L. Smith. English Speaking Union, Stanley Pl, Watergate St, Chester. 7 p.m.

I.E.E. (Scottish Centre). Diamond jubilee conversazione. Bute Hall, Glasgow University.

I.E.E. (Merseyside and N. Wales Centre). "The Electrification of the U.K.A.E.A. Industrial Group Factories," J. W. Binns and W. J. Outram. M.A.N.W.E.B. Service Centre, Buttermilk St, Warrington. 6.30 p.m.

I.E.E. SCOTTISH CENTRE JUBILEE. Conversazione. Bute Hall, Glasgow University. 7.30 p.m.

A.S.E.E. (S. London Branch). "The Work of the Royal Mint Refineries," J. T. McEvoy. Greyhound Hotel, High St, Croydon. 8 p.m.

FRIDAY, 29 JAN.

I.E.E. (Electronics and Communications Section). "Beam-Type Parametric Amplifiers: Some Aspects of Design and Use," R. B. Dyott and C. R. Russell. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (N. Ireland Centre). Dinner/dance at Grand Central Hotel, Belfast. 7.15 p.m.

I.E.E. (N.E. Graduate and Student Section). "Something for Nothing? Heat Pump Achievements," G. O. McLean. Grey Hall, King's College, Newcastle. 6.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS, "Ceramics," A. Dinsdale. Pepys Hse, 14 Rochester Row, S.W.1. 7 p.m.

I.E.S. (Newcastle Centre). Dinner/dance. County Hotel, Neville St, Newcastle. 6.15 p.m.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons Ltd., 116 Chancery La, W.C.2.

Blackhawk Ltd. Manufacturers of and dealers in hydraulic, electronic, pneumatic and mechanical tools, etc. Nom. cap.: £1,000. Dirs.: to be appointed by subs. Subs.: T. M. Lane and P. J. N. Presland.

P. Botfish Ltd., 117 Cricklewood Broadway, N.W.2. To carry on business of heating, ventilating, air conditioning, refrigeration and electrical engineers, etc. Nom. cap.: £1,000. Dirs.: Philip F. Botfish and Mrs N. Botfish.

C. and H. (Electronic Metals) Ltd., Riverside Works, Bridle Path, Beddington. Nom. cap.: £1,000. Dirs.: John E. Chaplin and John H. Hill.

Domec Ltd., Wingwood Hse, 1206 Stratford Rd, Hall Green, Birmingham 28. Manufacturers of and dealers in domestic, household and general electric and other equipment, etc. Nom. cap.: £1,000. Dirs.: Raymond J. McHenry and Reginald Skellam.

Ether Ltd. To carry on business of mechanical engineers, etc. Nom. cap.: £100. Dirs.: not named. Subs.: Gladys Crout and Marion Simmons, 59/67 Gresham St, E.C.2.

Evercool (Refrigeration) Ltd., 50 Bute St, Salford 5. Nom. cap.: £200. Dirs.: Ernest Priestley, James E. Hughes, Mrs Edna Priestley and Mrs Margaret Hughes.

F. Goodwin and Son (Electrical) Ltd. To take over business of electrical engineers and contractors and retailers of electrical equipment carried on at Leek by J., and Kathleen M. Goodwin, etc. Nom. cap.: £1,000. Dirs.: Sydney G. Harratt, 28a St. Johns Wood, Kidsgrove, Stoke-on-Trent; Wm. T. Carter, 14 Gaol Butts, Eccleshall; and Geoffrey A. Keates.

Grevfriars Productions (Fittings) Ltd., 14 Albany Rd, Coventry. To take over business of sales of electrical accessories carried on at "Priors Lea," Walsall Common, nr. Coventry. Nom. cap.: £5,000. Dirs.: Martyn Harold and Mrs Jose D. Harold.

Hare and Hooker Ltd., 334 Eden Park Ave, Beckenham, Kent. Electrical and mechanical contractors, etc. Nom. cap.: £1,000. Dirs.: Ronald F. Hooker and John G. Hare.

Nu-Gun Teletubes Ltd., Barclays Bank Chmbrs, Edmonton, N.9. Manufacturers of and dealers in radio, electrical and mechanical apparatus, etc. Nom. cap.: £100. Dirs.: James D. C. Henderson and Leslie B. Henderson.

Harold Payne Ltd., 7 Highfield Cres, Blackheath, Birmingham. To carry on business of electrical engineers and contractors, etc. Nom. cap.: £1,000. Permanent dirs.: Percival H. Payne and Mrs S. Payne.

Transitron Electronic Ltd. To carry on business of electronic, electrical and mechanical engineers, etc. Nom. cap.: £1,000. Dirs.: David Bakalar and Leo Bakalar. Subs.: T. M. Lane, 7/8 Norfolk St, W.C.2; and Peter J. N. Presland, 23a Tedworth Sq, S.W.3.

Watford Trading Co. Ltd., 173 Queens Rd, Watford, Herts. Distributors of and dealers in electrical goods, etc. Nom. cap.: £100. Dirs.: Frank Arliss, Walter F. Carlisle and Fredk. J. Kelsey.

G. J. Williams (Electrical Contractors) Ltd., 64 Tudor Rd, Hayes End. Nom. cap.: £1,000. Dir.: Gilbert J. Williams.

CONTRACTS PLACED

Manchester. Electrification of underground car park off Market St. Frank Wall and Co.

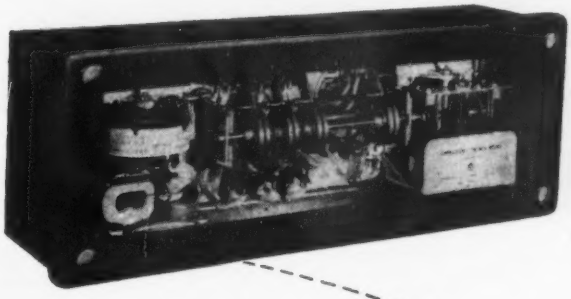
Newcastle-on-Tyne T.C. Improvements to lighting at Heaton High and Grammar Schools. Robson and Coleman Ltd., £2,587 16s 3d.

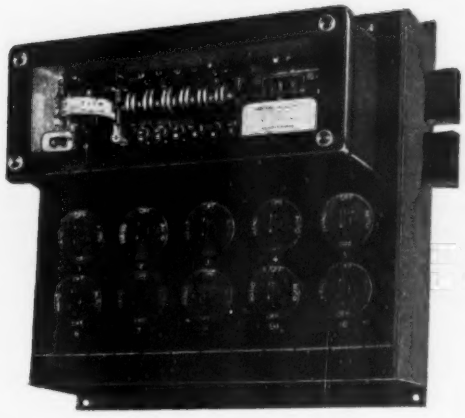
Ryton U.D.C. Lighting and heating installations in 36 houses at Heddon View. Tindale, Son and Telford.

Choose AEI relays and correct Power Factor AUTOMATICALLY

Type NJO4 relay for the control of single-step power capacitors.

A complete range of AEI relays is available for the control of capacitors as a means of improving the power-factor of industrial loads. Please write for full details.





Type NJO3 relay for the control of a number of capacitors or capacitor sections in sequence. It may be switchboard or wall-mounting pattern with or without control switches.

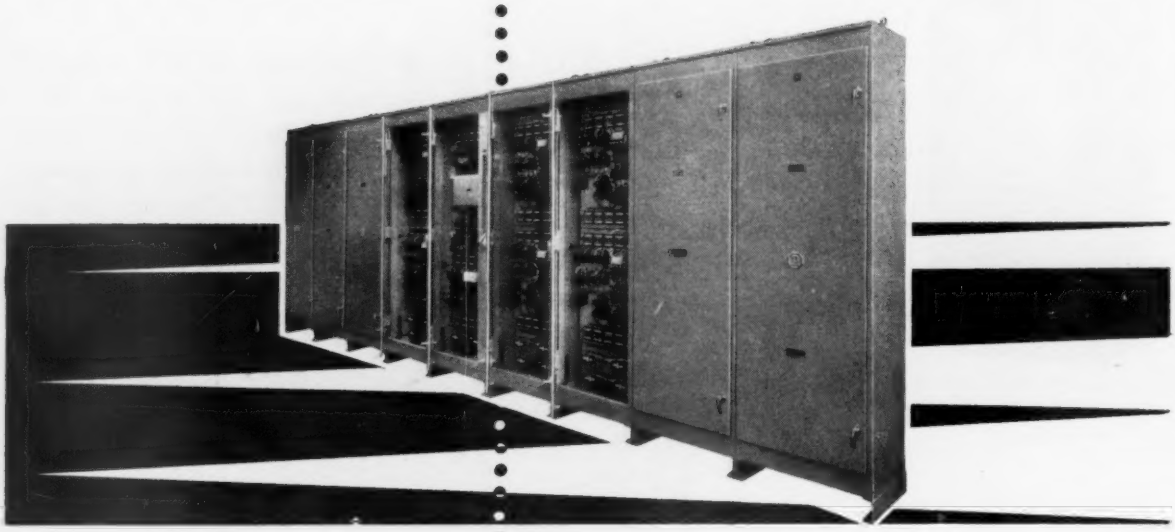
Associated Electrical Industries Limited

INSTRUMENTATION DIVISION - Instrument & Meter Department

Trafford Park, Manchester 17

G/A 704

SPECIAL PURPOSE CONTROL PANELS BY Donovan



This **SPECIAL** 9-door switchboard controlling a 19-station Metalworking In-Line Transfer Machine may look like any other switchboard **BUT—**

STANDARD, PROVEN Donovan Contactors, Relays, Overloads Isolators and accessories, are used throughout and in addition the panels are **plug-in** for quick replacement and maintenance—**a valuable feature only offered by Donovan.**

Senior Executives and Buyers desiring a comprehensive List of Donovan standard and special products are invited to apply for copies of the Donovan Catalogue.

THE DONOVAN ELECTRICAL CO. LTD.

77-82 GRANVILLE STREET, BIRMINGHAM, 1

LONDON DEPOT: 148-151 York Way, N.7. GLASGOW DEPOT: 22 Pitt Street, C.2

Sales Engineers available in LONDON · BIRMINGHAM · MANCHESTER · GLASGOW · BELFAST · BOURNEMOUTH

CLASSIFIED ADVERTISEMENTS

TENDERS INVITED

NOTTINGHAMSHIRE COUNTY COUNCIL
Highways Committee

STREET LIGHTING

TENDERS are invited for the supply and erection of street lamp columns including lanterns and switchgear on the traffic island at the south end of the Doncaster Bypass, and sited at the north of Blyth Cut, on the Nottingham-Bawtry Road A614.

General Conditions of Contract, Specification and Bill of Quantities are obtainable from the County Surveyor, Shire Hall, Nottingham, on payment of a deposit of £2, which will be returned on receipt of a bona fide tender not subsequently withdrawn and the return of the documents.

The Contract drawings may be inspected at the office of the County Surveyor during normal office hours.

Tenders should be returned, in the official envelope provided, to the undersigned by 4 March, 1960.

The Council does not bind itself to accept the lowest or any tender.

A. R. DAVIS,
Clerk of the County Council.

County Hall,
West Bridgford,
Nottingham. (N 631)

ST. ALBANS RURAL DISTRICT COUNCIL
WATFORD RURAL DISTRICT COUNCIL

STREET LIGHTING
NORTH ORBITAL ROAD, A405

THE above-mentioned Councils invite tenders for contiguous street lighting schemes on the North Orbital Road A405 (Trunk Road).

Contractors wishing to tender for the installations should apply to the Engineers at the addresses below for further details within seven days from the publication of this advertisement.

ERIC N. WHEELER,
Clerk of the St. Albans R.D.C.

S. A. NICHOLSON,
Clerk of the Watford R.D.C.

43 Upper Lattimore Rd.
St. Albans, Herts.

Wynyard Hse,
Langley Rd,
Watford, Herts. (N 648)

BOROUGH OF HIGH WYCOMBE
Street Lighting

WYCOMBE/AMERSHAM ROAD A404

TENDERS are invited for the following:

(1) Supply and erection of steel lighting columns and installation of auxiliary equipment, lanterns, wiring, etc.;

(2) Supply of lanterns, 250 Watt mercury discharge lamps and sets of auxiliary equipment.

Specifications, Bills of Quantities and Forms of Tender may be obtained from the undersigned and the Drawings and Conditions of Contract may be inspected at the the Borough Engineer's Office, Municipal Offices, High Wycombe.

Tenders in a sealed envelope which shall bear no name or mark indicating the sender, but endorsed:

(1) "Tender Section A supply and erection of lighting columns";

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(2) "Tender—Section B supply of lanterns and auxiliary equipment":

must be delivered to the undersigned not later than Wednesday, 17 Feb., 1960.

The Council do not bind themselves to accept the lowest or any tender.

J. A. PARKINSON,
Borough Engineer & Surveyor.
(N 649)

COUNTY BOROUGH OF BARNSLEY
Borough Engineer and Surveyor's Department

TENDERS FOR MATERIALS, 1960/61

TENDERS are invited for the supply of the following materials for the 12 months ending 31 March, 1961:

1. Tarred Slag.
2. Bitumen, Macadam and Fine Cold Asphalt.
3. Gravel and Sand.
4. Concrete Kerbs, Edgings and Flags.
5. Concrete Pipes, Gully Pots and Manholes.
6. Salt-glazed Earthenware Pipes.
7. Cement.
8. Cast-iron Manhole Covers and Gully Gratings.
9. Tar.
10. Bitumen.
11. Cold Emulsions.
12. Concrete Public Lighting Columns.
13. Electric Lamps for Public Lighting Purposes (Tungsten Filament).
14. Electric Lamps for Public Lighting Purposes (Mercury-Vapour and Sodium).

Copies of the Specifications and Forms of Tender may be obtained on application to the Borough Engineer and Surveyor, Town Hall, Barnsley.

Sealed tenders in envelopes provided, must be delivered to the undersigned not later than Tuesday, 16 Feb., 1960.

The Council do not bind themselves to accept the lowest or any tender.

A. E. GILFILLAN,
Town Clerk.

Town Hall,
Barnsley.
1960. (N 661)

APPOINTMENTS VACANT

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD
No. 2 Sub-Area

ASSISTANT SECTION ENGINEER

REQUIRED in the St. Helens District. Salary within range £860/£905 per annum (N.J.B., G/9).

Applicants should have received an engineering training and have had experience in H.V. and M.V. overhead and underground distribution work. Technical qualifications desirable.

Appointment subject to medical examination. Pension scheme.

Application forms obtainable from the Manager, No. 2 Sub-Area, Sandiway Hse, Northwich, Cheshire. Closing date: 1 Feb., 1960. (N 643)

THE NORTH EASTERN ELECTRICITY BOARD
Harrogate Sub-Area

APPLICATIONS are invited for the appointment of SECOND ASSISTANT ENGINEER (SURVEY), Harrogate Sub-Area Headquarters. Applicants should be suitably qualified engineers with a basic knowledge of H.V. and L.V. overhead line design and construction methods. Experience in surveying of overhead line and cable routes including the preparation of erection schedules, is essential.

Applications stating age, qualifications and experience, to be received by Assistant Secretary (Establishments), The North Eastern Electricity Board, GPO Box No. 117, Carliol Hse, Newcastle upon Tyne, within 10 days of the appearance of this advertisement. (N645)

FEDERAL POWER BOARD OF RHODESIA AND NYASALAND
System Operation Department

APPOINTMENT OF

(1) SENIOR CONTROL CENTRE ENGINEER
(ONE VACANCY)

(2) CONTROL CENTRE ENGINEERS
(FIVE VACANCIES)

(3) ASSISTANT CONTROL CENTRE ENGINEERS
(FIVE VACANCIES)

APPLICATIONS are invited for the above appointments at the Board's System Control Centre being built at Sherwood, about 120 miles south-west of Salisbury. The interconnected system to be controlled will initially consist of a 900-mile 330 kV transmission system linking certain existing power stations with the Kariba Hydro-Electric Scheme (initial capacity 600 MW, ultimate capacity at least 1,500 MW).

Applicants for (1) should be chartered Electrical Engineers and have had considerable experience in the operation of a large interconnected high-voltage system. Experience in power station operation and general administration would be an advantage. The successful candidate will work normal office hours and will be responsible to the System Operating Engineer for the operation of the System Control Centre. Salary £2,250 per annum.

Applicants for (2) should have had experience in the operation of an interconnected high-voltage system and preferably experience in power station operation. Qualifications leading to Associate Membership of a recognised Engineering Institution are desirable. The successful candidate will be responsible for the operation of the Board's interconnected system, including switching, load dispatching and associated duties. Salary £1,700 per annum, plus 10% shift allowance.

Applicants for (3) should possess adequate general and technical qualifications and preferably have had experience in high-voltage system or power station operation. Salary £1,400 per annum, plus 10% shift allowance.

All successful applicants will be required to contribute to the Board's Pension Fund. Housing and hard furniture will be provided by the Board at a reasonable rental in the town of Que Que (where there is the full range of Federal Government Schools) about 16 miles from Sherwood. Transport between Sherwood and Que Que will be provided.

The reasonable travelling and removal expenses of successful candidates and their families to Que Que will be paid by the Board.

Applications, giving full details of education, training, experience, age and marital status, should be posted so as to reach the Secretary, Federal Power Board, Reliance Hse, P.O. Box 630, Salisbury, Southern Rhodesia, not later than 5 March, 1960. (N 637)

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 40s. per inch, and all other classified advertisements at 3s. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.

SOUTH OF SCOTLAND ELECTRICITY BOARD

Glasgow Area

APPLICATIONS are invited to fill the undernoted vacancies:

SECOND ASSISTANT DISTRICT ENGINEERS (TWO VACANCIES)

(Ref. No. T/60/1)

THIRD ASSISTANT DISTRICT ENGINEER (EASTERN DISTRICT)

(Ref. No. T/60/2)

Applicants should have a sound engineering training with subsequent experience in the operation and maintenance of large distribution systems at voltages up to and including 33 kV. Experience in the planning and preparation of schemes for new development and network reinforcement would be an advantage.

The possession of qualifications leading to Graduate Membership of the Institution of Electrical Engineers is desirable.

Salary Scales: One Second Assistant (Western District), Class F, Grade 7, £910/£955 p.a.; One Second Assistant (Central District), Class H, Grade 7, £1,025/£1,085 p.a.: One Third Assistant, Class G, Grade 9, £860/£905 p.a.

GENERAL ASSISTANT DISTRICT ENGINEERS (FIVE VACANCIES)

WESTERN, EASTERN, SOUTHERN AND CENTRAL DISTRICTS

(Ref. No. T/60/3)

The minimum qualification for the positions will be the Ordinary National Certificate for Electrical Engineering and applicants should have some experience of E.H.V. and L.V. distribution systems and substation equipment.

Salary Scales: Class F, Grade 11, £710/£755 per annum; Class G, Grade 11, £765/£810 per annum; Class H, Grade 11, £815/£860 per annum.

FOURTH ASSISTANT ENGINEER (PLANNING AND DEVELOPMENT)

(Ref. No. T/60/4)

Applicants should have a sound engineering training with subsequent experience in the design and layout of large distribution systems at voltages up to and including 33 kV in a densely populated loaded area. A knowledge of the application of modern protective equipment and of the calculation of fault levels and preparation of load flow diagrams would be an advantage.

The possession of qualifications leading to Graduate Membership of the Institution of Electrical Engineers is desirable.

Salary Scale: Class L, Grade 13, £860/£905 per annum.

The above appointments will be superannuable. The conditions of employment will be in accordance with the National Joint Board Agreement for the Electricity Supply Industry and the successful candidates will require to reside within reasonable distance of the appropriate District or Area Headquarters.

Applications, quoting the relevant reference number, should be made on the standard form AE6, which may be obtained from the undersigned and should be completed and returned within 14 days of the appearance of this notice.

A. KELSO,
Manager.

P.O. Box 6,
75 Waterloo St,
Glasgow C.2. (N 605)

ELECTRICAL ENGINEER

Qualified

A VACANCY exists for a qualified Electrical Engineer with a Hydro-Electric Power undertaking in Northern Nigeria. Pleasant climate, 4,000 ft above sea level. Age 30 to 35. Salary grade £1,335/£1,565 according to age, qualification and experience. Pension and Life Assurance Scheme. Eighteen months' tours with three months' leave on full salary. Free furnished quarters. Free passages self, wife and two children, or equivalent benefits if children remain at home. Write Box D.401, c/o Streets, 110 Old Broad St, E.C.2. (N 609)

COUNTY BOROUGH OF WEST BROMWICH

Public Works Department

APPOINTMENT OF
ELECTRICAL TECHNICAL ASSISTANT

APPLICATIONS are invited for the above appointment at a salary in accordance with Grade A.P.T. II (£765/£880). The commencing salary will be fixed in accordance with qualifications and experience.

Candidates should be suitably qualified and experienced in the preparation of small schemes and specifications for electrical installation work, together with administration in routine maintenance.

The successful applicant will be required to control work by Direct Labour of the Electrical Section of the Public Works Department.

Applications stating age, qualifications, present salary, position and experience, accompanied by the names and addresses of two persons to whom reference may be made, should be delivered to the undersigned not later than 27 Jan., 1960.

W. H. GREENWOOD,
Borough Engineer and Surveyor.

Town Hall,
West Bromwich. (N 607)

LONDON ELECTRICITY BOARD

VACANCY—COMMERCIAL ENGINEER

APPLICATIONS are invited for the above position in the Board's Regency District.

Applicants should have had experience of consumers' service, development, tariffs, statistics, electrical contracting and maintenance, the design of space and water heating installations and the operation of Service Centres, etc. Corporate Membership of the Institution of Electrical Engineers would be an advantage.

The post is graded under Schedule A of the National Joint Board Agreement as Class J, Grade 6, £1,245 per annum to £1,320 per annum, inclusive of London Allowance.

Application form obtainable from Personnel Officer, 46 New Broad St, London E.C.2, to be returned completed within 14 days of the publication of this notice. Please quote ref.: PER/V/2834/T. (N 604)

GOVERNMENT OF WESTERN NIGERIA

VACANCIES FOR ELECTRICAL ENGINEERS

APPLICATIONS are invited for posts of Electrical Engineers.

Qualifications: Candidates should hold a University degree recognised by the Institution of Electrical Engineers, or a pass in or exemption from the final Parts I and II of the Institution's examinations and two years' post-qualification practical experience, which should be in addition to any period of articled apprenticeship.

Duties: The design, supervision installation, maintenance and repair of electrical equipments and installations in Government Buildings, Hospitals and Staff Quarters, etc. The investigation and application of modern forms of electrical wiring to tropical conditions and the design and installation of small supply schemes up to 100 kW.

Terms of Appointment: On contract terms for a minimum of one tour of 12-18 months in the first instance. Salary is within the range of £1,536/£2,286 per annum, according to experience since qualifying. Gratuity at the rate of £37 10s for each complete three months' service is payable. Free first class passages for officer and his family on first appointment and when proceeding on leave, free medical treatment for officer and his family. Accommodation is provided at low rentals.

Application should be completed in triplicate on the prescribed form obtainable from the Official Secretary (Recruitment Branch), Office of the Commissioner for Western Nigeria, 178/202 Great Portland St, London W.1, from whom further particulars may also be obtained.

Closing date: 28 Jan., 1960.

(N 603)

COUNTY COUNCIL OF THE WEST RIDING OF YORKSHIRE

Office of the County Architect

APPLICATIONS are invited for the undermentioned posts:

Central Office, Wakefield

JUNIOR ELECTRICAL ENGINEERING ASSISTANT

Grade APT. II, £765/£880.

Candidates should hold the Higher National Certificate in Electrical Engineering and be capable of preparing schemes, specifications and estimates.

Huddersfield Divisional Office

ELECTRICAL ENGINEERING INSPECTOR

Grade APT. I, £610/£765.

Candidates should hold the Ordinary National Certificate in Electrical Engineering and have had practical experience in inspecting, supervising and testing electric lighting and power installations, and be able to prepare specifications and drawings for simple maintenance schemes.

Applications to be submitted by the first post on Tuesday, 2 Feb., 1960, on forms to be obtained from and returned to the undersigned.

A. W. GLOVER, F.R.I.B.A.,
County Architect.

Bishopgarth,
Westfield Rd,
Wakefield. (N 614)

CENTRAL ELECTRICITY GENERATING BOARD

South Wales Division

Vacancy No. 8/ET/60.

APPLICATIONS invited for superannuable N.J.B. appointment of STATION CHEMIST, TIR JOHN POWER STATION, SWANSEA.

Salary: Class H, Grade 7 (£1,025/£1,085 per annum).

Applicants should possess B.Sc.(Chem.) and/or A.R.I.C. and have experience in water treatment, coal and oil testing and corrosion problems.

Special application froms obtainable from Divisional Secretary, South Wales Division, Central Electricity Generating Board, Twyn-y-fedwen Rd, Gabalfa, Cardiff, to be returned by 30 Jan., 1960. (N 606)

ROYAL BOROUGH OF KINGSTON UPON THAMES

APPOINTMENT OF ELECTRICIAN AND MAINTENANCE ENGINEER

APPLICATIONS invited for appointment of Electrician and Maintenance Engineer for the Guildhall to act under control of Borough Surveyor.

Applicants should be qualified electricians having served an apprenticeship, have technical and practical knowledge and a thorough training and experience in running and maintenance of heating, ventilating, lighting and lifts, and be able to carry out routine maintenance adjustments and repairs to electrical installations. Heating is by hot water circulating from storage vessels and electrode boiler (Sulzer Bros. Ltd.).

Rate of pay in accordance with an electrician under Schedule A day rates of the Electricity Supply Industry, i.e., 5s 2¾d per hour, plus 2¼d per hour (total rate 5s 5¼d) for standard week of 44 hours.

Permanent appointment, subject to provisions of the Local Government Superannuation Acts, and passing a medical examination.

The post will be subject to one week's notice on either side.

Applications, stating age, present employment, previous employment and experience, with dates, accompanied by copies of two recent testimonials, must reach the Borough Surveyor at the under-mentioned address not later than 4 Feb., 1960.

A. B. ROGERS,
Town Clerk.

Guildhall,
Kingston upon Thames. (N 617)

Box Number replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London, W.C.2

NEW ZEALAND MINISTRY OF WORKS
ENGINEERING STAFF

THE New Zealand Ministry of Works invites applications for the following vacancies on the Permanent Staff. Positions, qualifications desired and salaries offered are as follows:

Vacancy No. 3.
MECHANICAL OR ELECTRICAL ENGINEERS

Corporate Membership of the Institutions of Mechanical or Electrical Engineers, London, together with sufficient appropriate experience. Commencing salaries up to £1,525 p.a.

Vacancy No. 4.
BUILDING SERVICES ENGINEERS

Corporate Membership of the Institution of Heating and Ventilating Engineers, London. Commencing salaries up to £1,450 p.a.

Vacancy No. 5.
ASSISTANT MECHANICAL OR ELECTRICAL ENGINEERS

A university Degree in Mechanical Engineering or Graduate Membership of the Institutions of Mechanical or Electrical Engineers, London, together with at least five years' experience since commencement of pupilage. Commencing salaries: £870/£1,060 p.a.

Vacancy No. 6.
ASSISTANT BUILDING SERVICES ENGINEERS

Graduate Membership of the Institution of Heating and Ventilating Engineers, London, with at least five years' experience since commencement of pupilage. Commencing salaries £870/£1,060 p.a.

Experience is necessary in the design and installation of services or equipment for one or more of the following: heating and ventilating, air conditioning, hot and cold water or sewerage services, laundries, kitchens, boiler-houses, lifts and other mechanical services in offices, schools, hospitals, hotels, telephone exchanges, printing works, defence establishments, etc. All appointees will be required to undertake work of this nature.

Applicants must be Resident in the United Kingdom or Eire and have fulfilled National Service obligations.

Enquiries, mentioning this publication and stating the Vacancy Number and the position sought, should be addressed to the High Commissioner for New Zealand, 415 Strand, London W.C.2. Full details of duties, experience required, general information on the conditions of employment in the New Zealand Public Service and application forms will then be supplied. (N 528)

CENTRAL ELECTRICITY GENERATING BOARD
Southern Project Group
HINKLEY POINT NUCLEAR GENERATING STATION

SECOND ASSISTANT ENGINEER (INSTRUMENTATION)

APPLICATIONS are invited for the position of Second Assistant Engineer (Instrumentation) at Hinkley Point Generating Station now under construction.

The site is on the coast, approximately 10 miles north-west of Bridgwater, Somerset.

The successful applicant will be required to assist the Site Electrical Engineer in the supervision and commissioning of instrumentation in connection with both conventional and nuclear plant.

Applicants should have some works experience or apprenticeship training and previous experience on installation and commissioning of instruments and control equipment is essential. Experience in the nuclear instrumentation field is not essential, but would be an advantage.

Applicants should have qualifications up to Higher National Certificate and should preferably be Corporate Members of the Institution of Electrical Engineers.

This is a permanent appointment, and the successful candidate will be expected to live

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in the vicinity of the site for the duration of the construction work, which will be approximately three years. Opportunities will be available for transfer to future generating station sites and to the design teams associated with these stations.

The salary for the appointment will be within Grade 4 of Schedule C of the N.J.B. Agreement, i.e., £1,195/£1,545 per annum, according to qualifications and experience.

Applications, stating age, qualifications, experience, present position and salary should be forwarded to the Administrative Officer, Central Electricity Generating Board, Southern Project Group, Squires La, Finchley, London N., to arrive not later than Monday, 1 Feb., 1960.

Envelopes should be marked "Confidential—S/60/6." (N 634)

ADMINISTRATIVE COUNTY OF LEICESTER
ASSISTANT ELECTRICAL ENGINEER

£780/£1,070 according to qualifications. Candidates should be in possession of the Higher National Certificate in Electrical Engineering and be capable of preparing schemes for electrical installations in all types of buildings.

Lodging allowance and removal expenses may be paid to married men.

Apply by 5 Feb., 1960, on forms obtainable from County Architect, 123 London Rd, Leicester. (N 641)

BOROUGH OF HORNSEY
ASSISTANT MAINTENANCE ENGINEER

REQUIRED for Town Hall. Applicants should have experience in large public buildings and multi-purpose halls. Wage £14 (including overtime). Sick pay. Superannuation if under 45. Write Borough Engineer, Town Hall, N.8, for application form.

W. B. MURGATROYD,
Town Clerk.
(N 619)

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts:

North Staffs. Sub-Area
GENERAL ASSISTANT DISTRICT ENGINEER (LEEK)

Applicants should have had experience in the operation and maintenance of distribution systems. Technical qualifications desirable. Salary: £655/£700 per annum (N.J.B. Grade F.12). Apply, by letter, stating age, education, experience, qualifications, present position and salary, to Mr C. C. Pimble, Sub-Area Manager, Midlands Electricity Board, 234 Victoria Rd, Fenton, Stoke-on-Trent.

Shropshire and Herefordshire Sub-Area
GENERAL ASSISTANT DISTRICT ENGINEER (HEREFORD)

Applicants will be required to assist generally in the construction, maintenance and operation of H.V. and L.V. mains. Technical qualifications desirable. Salary: £710/£755 per annum (N.J.B. Grade F.11). Apply, by letter, within 14 days, stating age, experience, present position and salary, to Mr W. Winwood, Sub-Area Manager, Midlands Electricity Board, Spring Gardens, Ditherington, Shrewsbury.

Wolverhampton and District Sub-Area
GENERAL ASSISTANT DISTRICT COMMERCIAL ENGINEER (WALSALL)

Duties will include estimating for contracting work and advising consumers in the use of commercial electrical equipment. A sound knowledge of electrical installation practice is essential. Salary: £765/£810 per annum (N.J.B. Class G, Grade 11). Apply, by letter, within 14 days, stating age, qualifications, experience and present salary, to Mr D. Holt, Sub-Area Manager, Midlands Electricity Board, 83 Darlington St, Wolverhampton.

F. W. CATER,
Secretary.
(N 618)

CENTRAL ELECTRICITY GENERATING BOARD
South Eastern Division
Vacancy No. 15/60.

FOURTH ASSISTANT ENGINEER
TECHNICAL DEPARTMENT
MEASUREMENTS SECTION
BASED AT CROYDON POWER STATION

DUTIES cover maintenance of Power Station and Bulk Supply Metering and Instrumentation including instrument transformer testing and some site work. Experience in a Class A Polyphase or similar type of Testing Station and possession of the H.N.C. would be an advantage. Salary within the range £775 to £985 per annum including London Allowance.

Applications giving age and all relevant details to Mr G. H. D. Keen, Measurements Section, Croydon "B" Power Station, Beddington Farm Rd, Croydon, Surrey. Closing date 1 February. (N 657)

COUNTY BOROUGH OF CROYDON
ELECTRICAL ENGINEERING ASSISTANT

APPLICATIONS are invited for this superannuable appointment in the Borough Engineer's Department from persons who are suitably qualified.

Duties mainly preparation of specifications and drawings for electrical installations in all types of buildings.

Salary scales: £785/£910 p.a. (progressing to £1,100 p.a. when fully qualified); or £815/£1,100 p.a. with Part II of the examination. Commencing salary according to experience at any point within the appropriate scale.

Write to Borough Engineer, Town Hall, Croydon, for further particulars and application form.

Closing date: 8 Feb., 1960.

E. TABERNER,
Town Clerk.
(N 642)

SOUTH EASTERN ELECTRICITY BOARD
ASSISTANT DISTRICT ENGINEER
SUTTON DISTRICT

SALARY: £765 x £15—£810 per annum plus London Allowance under NJB, Class G, Grade 11. Superannuable. Applicants should possess the Higher National Certificate in Electrical Engineering and have had a thorough training in underground and overhead distribution systems. Applications, quoting ET and naming two referees, on forms from District Manager, Seeboard, 52 High St, Sutton, Surrey, by 3 Feb., 1960.

INSTALLATION INSPECTOR
CROYDON AND PURLEY DISTRICT

Wages: 5s 7½d per hour for a 44-hour 5-day week under N.J.I.C. Agreement. Hours will be reduced to 42 per week with the same weekly remuneration from 1 Feb., 1960. Superannuation optional after two years' service. Applicants must have a sound knowledge of the appropriate regulations and of medium and low voltage metering. Applications, quoting ET and naming two referees, to District Manager, Seeboard, Electric Hse, Wellesley Rd, Croydon, by 25 Jan., 1960.

ASSISTANT DISTRICT ENGINEER
SUTTON DISTRICT

Salary: £860 x £15—£905 p.a. under N.J.B., Class G, Grade 9, plus London Allowance. Superannuable. Applicants should have had a good general education, be technically trained up to Higher National Certificate standard and must have had practical experience in general distribution work on H.V. and L.V. systems. Ability to plan and prepare schemes for mains extensions would be an advantage. Applications, quoting ET and naming two referees, on forms from Surrey Manager, Seeboard, Rough Rew, Ridgeway Rd, Dorking, Surrey, by 3 Feb., 1960.

GEORGE WRAY,
Secretary.
(N 646)

SOUTH WESTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following positions:

FOURTH ASSISTANT ENGINEER
BRISTOL GROUP

Salary according to Class L, Grade 13, £860 x £15—£905 per annum, of the N.J.B. Agreement.

The successful candidate will be required to assist generally in the technical work of the Group Engineering Department, including system planning and design; load forecasts; technical reports and calculations; system operation and construction progressing.

Applicants should have had experience of the construction and operation of distribution systems up to 33 kV. Possession of qualifications at least equivalent to the Higher National Certificate in Electrical Engineering is desirable.

ENGINEERING DRAUGHTSMAN
BRISTOL GROUP

Salary within Grade 6, £620 x £20—£740 per annum, of Schedule D of the N.J.B. Agreement.

The successful candidate will be required to undertake Ordnance and Overhead Line Survey duties using standard surveying instruments. He should also be capable, under supervision, of estimating and preparing drawings associated with Overhead Line schemes.

Possession of a current driving licence and qualifications leading to the Higher National Certificate in Electrical Engineering are desirable.

Applications for the above posts to be made on standard form AE6/ACT, obtainable by postcard only, from the Group Administrative Officer, South Western Electricity Board, Electricity Hse, Colston Ave, Bristol 1. Closing date for receipt of completed applications is 6 Feb., 1960. (N 644)

YORKSHIRE ELECTRICITY BOARD

Head Office

TRAINEE SHIFT CONTROL ENGINEER

THE successful applicant, who should have had operational experience and should hold the Higher National Certificate or its equivalent, will undergo a course of training in one of the Board's five Regional Control Centres, and expenses will be paid during the training period.

Salary: During training: N.J.B. scale AX-EX, Grade 6 (plus 10% shift enhancement), £1,017 10s x £27 10s—£1,155 rising to £1,287 per annum; and on taking over responsibilities for a shift: N.J.B. scale AX-EX, Grade 5 (plus 10% shift enhancement), £1,199 x £27 10s—£1,336 10s, rising to £1,490 10s per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Secretary, Head Office, Yorkshire Electricity Board, Wetherby Rd, Scarcroft, nr. Leeds, not later than 5 Feb., 1960.

No. 3 (Sheffield) Sub-Area

FOURTH ASSISTANT ENGINEER
(OPERATION AND MAINTENANCE)

Applicants should have had experience on high-voltage electrical distribution systems, and should be technically qualified up to Higher National Certificate standard.

Salary: N.J.B. Class M, Grade 13, £910 x £15—£955 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 3 (Sheffield) Sub-Area, Yorkshire Electricity Board, Commercial St, Sheffield, not later than 5 Feb., 1960.

No. 1 (Bradford) Sub-Area

BRADFORD DISTRICT
ASSISTANT CONSUMERS' ENGINEER

Candidates should hold the Higher National Certificate in Electrical Engineering or an equivalent technical qualification. They should be capable of preparing specifications in respect of lighting, heating and power installations and of dealing with con-

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sumers' queries regarding the application of electricity for domestic, commercial and industrial purposes.

Salary: N.J.B. Class J, Grade 12, £815 x £15—£860 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 1 (Bradford) Sub-Area, Yorkshire Electricity Board, 45-53 Sunbridge Rd, Bradford, not later than 5 Feb., 1960. (N 635)

METROPOLITAN BOROUGH OF FULHAM

Borough Engineer and Surveyor's Department

ELECTRICAL ENGINEERING ASSISTANT—N.J.C. Special Scale, £785/£1,070 plus £30 per annum London Weighting, commencing according to qualifications and experience. Experience in the design and installation of street lighting essential and good general experience of electrical installations is also required. Membership of I.E.E., A.P.L.E. or I.E.S. an advantage. Details from Town Clerk, Town Hall, S.W.6. Closing date: 8 Feb., 1960. (N 658)

LONDON ELECTRICITY BOARD

GENERAL ASSISTANT ENGINEERS

APPLICATIONS are invited for the above positions. Initially the successful candidates will be located at Battersea, S.W.11, or Walthamstow, E.17.

Applicants should have a sound technical education to the standard of the H.N.C. and have completed a recognised period of training in the electricity industry or have equivalent experience.

Pending determination as to the grading and salary applicable to the posts within the National Joint Board Agreement, the provisional minimum salary will be within the range £610 per annum, rising to £745 per annum, inclusive of London allowance.

Application form obtainable from Personnel Officer, 46 New Broad St, London, E.C.2, to be returned completed within 14 days of the publication date of this advertisement. Please state location preferred and quote ref. PER/V/2799/T. (N 662)

THE SOUTH WALES ELECTRICITY BOARD

SENIOR DEMONSTRATOR

APPLICATIONS are invited for the position of Senior Demonstrator in the Swansea District of the Swansea and West Central Area of the Board.

Candidates must be competent to give demonstrations and lectures in public halls, consumers' houses or showrooms on cooking, laundering or housecraft subjects. They should also have sales ability for showroom duties and a good knowledge of electrical appliances.

The qualifications required are the Diploma of a recognised Domestic Science College, or the Demonstrators' Certificate, and candidates should hold the E.A.W. Certificate.

The person appointed will be required to take part in the agreed rota of Saturday working.

The salary for the position will be in accordance with Grade 2 (£640/£700) of the National Joint Council (Administrative and Clerical Grades) Agreement for the Electricity Supply Industry.

Applications, stating age, qualifications, experience and particulars of present duties should be addressed to the Secretary at St. Mellons, Cardiff, so as to reach him not later than Monday, 29 Feb., 1960.

Envelopes should be marked "Senior Demonstrator—8/60." (N 633)

THE NORTH WESTERN ELECTRICITY BOARD

APPOINTMENT OF SECRETARY

APPLICATIONS are invited from suitably qualified and experienced persons for the post of Secretary on a salary within the range £3,500/£4,000 per annum.

Applications must state age, salary, experience and present position and responsibility of the applicant, together with the names of three referees.

The closing date is 5 Feb., 1960.

Correspondence must be addressed to: Mr T. E. Daniel, Chairman, The North Western Electricity Board, Cheetwood Rd, Manchester 8. (N 627)

SOUTH OF SCOTLAND ELECTRICITY BOARD

Ayrshire Area

APPLICATIONS are invited for the superannuable post of SECOND ASSISTANT DISTRICT ENGINEER, Mauchline District. Applicants should hold the H.N.C. in Electrical Engineering and have had experience in overhead and underground systems up to 33 kV. Salary: N.J.B. Class E, Grade 7, £860/£905 p.a. A house can be made available to the successful applicant.

Applications on the standard form should reach G. F. Moore, Manager, Greenholme St, Kilmarnock, by 10 Feb., 1960. (N 665)

CENTRAL ELECTRICITY GENERATING BOARD

Midlands Division

STATION SHIFT CONTROL ENGINEER

REQUIRED at Meaford "A" Power Station. N.J.B. service conditions, superannuable appointment salary within Schedule A of the Agreement, Grade G10, £815/£860 per annum, plus £90 Shift Allowance.

A sound technical training and practical experience in the control of steam generating plant and main switchgear are required. Appropriate technical qualifications an advantage.

Apply, quoting vacancy number MD.9/60 on form AE6, available from the Establishments Officer, 53 Wake Green Rd, Moseley, Birmingham 13, by 1 Feb., 1960. (N 639)

COUNTY BOROUGH OF WIGAN

Borough Engineer's Department

APPOINTMENT OF STREET LIGHTING FOREMAN

APPLICATIONS are invited for a working Foreman to take charge of the Streets Lighting Section, under the Borough Engineer.

The wage attached to the post will be 20% above the craftsmen's rate—present craftsmen's rate 4s 10½d per hour.

Applications on forms obtainable from the Borough and Water Engineer, Municipal Bldgs, Howlett St, Wigan, accompanied by copies of two recent testimonials, should be returned to the Borough and Water Engineer, not later than 9 a.m. on Friday, 5 Feb., 1960.

ALLAN ROYLE,
Town Clerk.

Municipal Bldgs,
Wigan. (N 663)

CENTRAL ELECTRICITY GENERATING BOARD

Midlands Division

SHIFT CHARGE ENGINEER

REQUIRED at Worcester Power Station. N.J.B. Service conditions, superannuable appointment, salary within Schedule A, Grade E.7, £860/£905 per annum, plus shift allowance.

Applicants should have a sound technical training and practical experience in the operation and maintenance of steam generating plant and main switchgear. Appropriate qualifications desirable. Applicants who applied for this position when advertised in November will be considered and need not reapply.

Apply, quoting vacancy number 10/60MD on Form AE6 to the Establishments Officer, 53 Wake Green Rd, Moseley, Birmingham 13, by 1 Feb., 1960. (N 638)

THE NORTH WESTERN ELECTRICITY BOARD

DISTRICT COMMERCIAL ENGINEER

MACCLESFIELD DISTRICT

DUTIES will include the organisation and control of commercial staff and functions in the District: supply of information and advice to consumers on all commercial matters: control of contracting section, service centres and exhibitions. Corporate Membership of the Institution of Electrical Engineers will be an advantage.

Salary scale: £1,360 x £30—£1,450, Grade G.2. N.J.B. conditions.

Applications must be made on a form to be obtained from the Manager, No. 3 Sub-Area, The North Western Electricity Board, Union St, Oldham, and returned to him so as to be received not later than 3 Feb., 1960. (N 628)

EASTERN ELECTRICITY BOARD

Fens Sub-Area

12/60.R.

DRAUGHTSMAN

SUB-AREA HEADQUARTERS

APPLICATIONS are invited for the position of Draughtsman at Milton Hall. Candidates should have good cartographic experience and be capable of maintaining records. Some building drawing experience would be an advantage.

Salary: N.J.C. Grade 2 (£640/£700).

The successful candidate will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

Apply by letter to the Secretarial Officer, Fens Sub-Area, Eastern Electricity Board, Milton Hall, Milton, Cambridge, by 5 Feb., 1960. (N 640)

UGANDA GOVERNMENT

APPRENTICE MASTER (ELECTRICAL)

REQUIRED by Public Works Department on contract for tour of 30-36 months in first instance. Gross salary according to experience in scale £813 rising to £1,341 a year. Gratuity at rate 13½% of total salary drawn. Outfit allowance £30. Free passages. Liberal leave on full salary. Candidates, preferably under 45 years of age, must have served a full apprenticeship as an electrician, have had considerable subsequent practical experience and possess O.N.C. (Electrical). Candidates having some experience in training electrical craft apprentices in a large organisation would be preferred. Write to the Crown Agents, 4 Millbank, London S.W.1. State age, name in block letters, full qualifications and experience and quote M2A/50710/EE. (N 632)

SOUTHERN ELECTRICITY BOARD

GENERAL ASSISTANT ENGINEER

ALDERSHOT District of No. 3 (Portsmouth) Sub-Area, located at Petworth. Salary: N.J.B. Class G, Grade 12 (£710 x £15—£755 per annum), N.J.B. conditions of service.

Applicants will be required to assist in distribution duties including minor construction work and general maintenance of H.V. and L.V. overhead and underground distribution systems, substation plant, etc., and possess suitable technical qualifications. The appointment will involve standby duties.

The successful candidate will be required to contribute to the Electricity Supply (Staff) Superannuation Scheme, if eligible.

Applications on forms obtainable from the Sub-Area Secretary, Lower Drayton La, Cosham, Portsmouth, and returned to him quoting Z.1155, not later than 1 Feb., 1960. (N 636)

CABLE JOINTERS.—Large manufacturers require Cable Jointers having previous experience of all classes of work up to and including 22 kV and "live" L.T. jointing. London rates of pay and Out Allowance. Applicants would be required to travel to any part of the country and should write stating age and brief details of previous experience to: Box No. 7669, Electrical Times. (N 622)

SENIOR ELECTRICAL ENGINEER

Famous Retail Multiple Stores require a Senior Electrical Engineer to join a team engaged on the design and planning of engineering installations for new stores.

Candidates should have at least five years' practical experience of electrical contract work connected with the building industry, covering site supervision, estimating and design. They should also be thoroughly familiar with distribution technique, design of control circuits for heating, ventilation and air conditioning and with modern development in lighting. Preference will be given to candidates previously employed by Consultants engaged on large projects. Mechanical engineering experience of heating, ventilation and lift installations would be an advantage.

Applicants should have a degree in Electrical Engineering and be Associate members of the Institution of Electrical Engineers. Preferred age 30 to 35. Initial salary in the range of £1,500/£2,000 or up to £2,500 for an exceptional candidate. There are excellent prospects of promotion. Ref. No. 47.

Please reply in confidence, quoting reference number, to:

Robert Clive (Consultants) Limited

Appointments Consultants

27 ALBEMARLE STREET LONDON W.1 (N 620)

CHECKERS AND SENIOR DRAUGHTSMEN are required for the design of complete electrical installations for Oil Refineries, Chemical Plants, and similar projects. Pension and life assurance scheme. Apply in writing stating age, qualifications, experience and salary required, to Foster Wheeler Ltd., 3 Ixworth Pl, London S.W.3. (N 600)

ELECTRICIANS

Electricians required for general maintenance and installation work on large integrated Iron and Steel Works. Excellent conditions. Pension Scheme in operation. Apply to: **The Employment Officer, Appleby-Frodingham Steel Co., Scunthorpe, Lincs.**

(N 523)

CITY Merchants have vacancy in their Electrical Merchandise Export Department for an ASSISTANT able to work on own initiative. This is a permanent position with prospects and there is a pension. Send full details to Box No. 7681, Electrical Times. (N 656)

CABLE ENGINEER for A.E.I. Cable Division. An opportunity exists for a FULLY QUALIFIED ENGINEER to take control of development in the super tension cables and accessories department of the newly formed Cable Division. The post is London based and is permanent and pensionable. Salary will be in the region of £2,000 although a higher figure will be considered in the case of applicants possessing broad experience and a special aptitude for high voltage work in this field. Please write with full details to Staff Officer, Ref. 744/2/ET, Associated Electrical Industries (Woolwich), London S.E.18. (N 602)

ELECTRICAL ENGINEER required by London Consulting Engineers for preparation of design, specifications, etc., for schools, hospitals and commercial buildings. Write stating age, experience, qualifications and salary required to Box No. 7393, Electrical Times. (N 18)

ELECTRICAL CONTRACTOR'S DRAUGHTSMAN with some experience of estimating required by Kuwait Associates. Salary: £1,000/£1,200 per annum. Free furnished accommodation. Cost of living allowance £37 10s per month. Single man preferred as no married accommodation available for first two years. Contract on yearly basis with option of renewal. Paid leave at rate of 36 days per annum on total overseas service if tour extended to second year. Applications, stating age and experience, to: Drake and Gorham (Contractors) Ltd., 36 Grosvenor Gardens, London S.W.1. (N 544)

BRUCE PEEBLES & CO. LIMITED

East Pilton, Edinburgh 5

require a

SENIOR TRANSFORMER DESIGNER

Applicants should have wide experience in transformer drawing office practice and particularly on units of the largest ratings and highest voltages.

Salary will be in accordance with ability and experience.

Applications will be treated in confidence and should be addressed to the Chief Engineer.

(N 615)

PHILIPS ELECTRICAL INDUSTRIES LIMITED

have vacancies for

ELECTRICAL DRAUGHTSMEN

in their

CENTRAL PLANT DEPARTMENT

at

CROYDON, SURREY

The work involves the design and lay-out of power and lighting installations for large factories and office blocks. Candidates should have electrical drawing office experience, and preferably have reached O.N.C. (Elect.) standard.

Commencing salaries will be according to age and experience, and the Company's conditions of employment include progressive pension, life assurance, holiday and sick pay schemes.

Applications, in writing, should be addressed to:

The Personnel Officer (4/ET),
Philips Electrical Industries Limited,
Waddon Hse, Stafford Rd,
Croydon, Surrey. (N 568)

ELECTRICAL CONTRACTS SUPERVISOR required for the Electrical Division of a large Building Contractor. Experienced in installations of Schools, Factories, Office Blocks. Capable of handling labour. Aged 35-45, good salary, pension scheme, other attractive conditions. State age, training and experience to Box No. 7657, Electrical Times. (N 559)

ENERGETIC SALES ENGINEER required for Midlands area to develop Sales of a wide range of M.V. Switchgear preparatory to establishing a Depot. Connections desirable with Consultants, Leading Contractors, Electricity Board and Industrial Users for Cubicles, Metalclad Switchboards, complete range of Fuse and Switchgear, Substation Boards, Feeder Pillars, Busbar Trunking. Please give full experience, present salary, etc., in confidence to: Managing Director, Messrs G. P. Dennis Ltd., Speke, Liverpool. (N 571)

ENERGETIC AGENT/REPRESENTATIVE required for Lancashire and Cheshire, by rapidly expanding light engineering company.—Box No. 7675, Electrical Times. (N 625)

EXPANDING BRITISH COMPANY IN IRAN

require

ELECTRICAL CONTRACTING BRANCH MANAGER

Previous experience of managing Contracting Organisation in all its aspects is essential. Minimum age 30. Commencing salary including allowances will be in the region of £3,500, but will be dependent upon experience and ability. Company car provided. Write giving fullest particulars of marital status, past experience, employers and periods of employment, quoting reference M.T.1, to Box No. 7667, Electrical Times. (N 616)

RAILWAY ELECTRIFICATION

ASSISTANT FOREMAN REQUIRED

temporarily based at Chadwell Heath, Essex, for ultimate employment at Romford or Pitsea.

Applicants should have served a recognised apprenticeship and be experienced in the installation, repair and maintenance of substations, supervisory control equipment, E.H.T. and L.T. cables. Should have knowledge of Isolation and Isolation Procedure. Technical qualifications desirable.

Rate of pay for 44-hour week is £670 p.a. rising to £709 after two years. Enhanced pay for overtime and Sunday duty. Certain free and reduced rate rail travel facilities. Pension and Sick Pay schemes.

Successful applicant must pass medical examination.

Apply in writing to:

Electric Traction Engineer (London Area),
BRITISH RAILWAYS, Eastern Region,
off Ley Street, ILFORD, Essex.

(N 647)

ENGINEERS required for the erection of steel tower and wood pole overhead transmission lines, at home or overseas. Applicant should have a general engineering background. Experience desirable but not essential. Pension fund. Apply in writing to Staff Officer, British Insulated Callender's Construction Co. Ltd., 30 Leicester Sq, London W.C.2. (N 629)

SWITCHGEAR DRAUGHTSMEN

Development and Contract Draughtsmen with experience of switchgear up to and including 33 kV required by Johnson and Phillips Ltd., at their new Switchgear Factory at New Cross or at a drawing office in Central London. Five-day week, good salary, pension scheme, excellent staff conditions. Applications stating age, experience, etc., to Employment Manager, Johnson and Phillips Ltd., Charlton, S.E.7.

(N 652)

ELECTRICAL ENGINEER required for Head Office Staff. Degree or Graduate Membership of I.E.E. and practical training at manufacturer of electrical machines. Upper age limit 35. Progressive salary with non-contributory pension. Applications stating age, nationality, qualifications and experience to British Engine Boiler and Electrical Insurance Co. Ltd., Longridge Hse, Manchester 4. (N 630)

ESTIMATING ENGINEER required for Electrical Engineers' and Contractors' Office, Westminster. Pension and bonus schemes in operation. Applicants with experience of estimating, installation contracts, apply stating details of age and experience to Box No. 7683, Electrical Times. (N 660)

HUMPHREYS & GLASGOW LIMITED

require electrical engineers in connection with chemical and gas plant design for their London Office.

(a) ELECTRICAL ENGINEERS experienced in design of complete power and lighting installations. Must be able to prepare complete schemes and specifications for lighting and heating, and handle contracts from enquiry to commissioning. Minimum qualification A.M.I.E.E.

(b) ELECTRICAL ASSISTANTS with sound practical experience and preferably some Drawing Office experience to work with Electrical Engineers. Minimum qualification ONC, studying for HNC.

Apply in writing to D. W. Eagle, Electrical Engineer, Humphreys and Glasgow Ltd., 22 Carlisle Pl, London S.W.1.

(N 613)

ELECTRICAL TECHNICAL ASSISTANT to Manager of Electrical Contractors engaged on installation contracts for large office blocks, schools, flats and industrial buildings. Good technical training with drawing office experience essential. Knowledge estimating and administrative flair desirable. Pension scheme, progressive salary with excellent prospects for suitable applicant aged 26-38. State age, qualifications, experience and present salary to Box No. 7671, Electrical Times. (N 623)

INSTRUMENT TRANSFORMER DESIGNER

Applications are invited from suitably qualified men with experience in this field. The post is permanent and pensionable and carries good prospects. Modern factory, with excellent canteen facilities. Applications stating age, training and experience to: Employment Manager, Johnson and Phillips Ltd., Victoria Way, Charlton, S.E.7.

(N 651)

PLUMBER JOINTERS, H.V. and L.V., required for Contracting work. Applicants should be willing to undertake a trade test. Box No. 7645, Electrical Times. (N 534)

SENIOR TRANSFORMER DESIGNER

Required by

A well-established Company in the South of England.

Applicants should have Degree or H.N.C. and preferably some years' experience with transformers up to 20,000 kVA and 66 kV, with on-load tap changing gear.

The post carries a progressive salary combined with excellent conditions of employment including superannuation.

Written application giving full details of age, nationality, qualifications, experience and salary required, to:

Box No. 7677, Electrical Times.

(N 650)

SALES REPRESENTATIVE

Required by British Company specialising in the manufacture of electrical terminals. Applications are invited from those with good education and ability to make contacts at executive level. Electro-technical experience essential. Practical switchgear experience also an advantage.

Remuneration during a probationary period of one year will be in the form of a fixed salary, thereafter remuneration to include commission. Car provided if necessary.

Applications in writing stating age, previous experience and salary required should be made to:

W. E. Fox, c/o Howard Howes & Co., 28 Norfolk Street, Strand, W.C.2

(N 659)

LEADING ROTARY SWITCH MANUFACTURERS wish to appoint a number of REPRESENTATIVES. Good connections are essential and will qualify for generous remuneration and expenses.—Box No. 7673, Electrical Times. (N 624)

PLANT ENGINEER.—If you have a good honours degree in electrical engineering or corporate membership of the Institution of Electrical Engineers, and would like a responsible position in a processing works of the Commonwealth's largest glass manufacturing organisation, you are invited to write direct to the Works Engineer, City Rd Wks, Pilkington Brothers Ltd., St. Helens, Lancs, quoting reference CRPE/9. You would be responsible for supervising planned maintenance, both mechanical and electrical, of plant and buildings worth £1,000,000, estimating capital electrical projects, negotiating contracts and general plant development. The power source of the works is entirely electrical, 160,000 kWh per week. You would have ample scope for initiative and responsibility and there would be opportunity for further promotion within the group. (N 653)

DRAUGHTSMAN (ELECTRICAL)

REQUIRED by the United Kingdom Atomic Energy Authority, Production Group, Springfield Works, Preston, Lancashire, to prepare layouts in connection with large scale electrical distribution systems covering all classes of electrical equipment.

An O.N.C., or equivalent, in electrical engineering, and at least three years' workshop experience, are essential. Relevant drawing office experience is preferable.

Salary: £585 (at age 21) to £915 per annum.

Staff Housing Scheme. Contributory Superannuation.

Send postcard for application form, quoting reference SF.21/J8, to Works Secretary at above address.

Closing date: 8 Feb., 1960. (N 608)

SALES ENGINEERS with established connections in the London, Birmingham and Leeds areas to represent a well established company manufacturing Motors and Electric Control Gear. Apply in confidence with full details to Box 7659, Electrical Times. (N 562)

SENIOR ELECTRICAL DRAUGHTSMEN (design) required for Northern Ireland, having experience particularly in the ranges of induction motors 1 to 200 h.p. and 200 to 2,000 h.p. Additional experience in alternators an advantage. Good salaries. Progressive positions. Pension scheme. Reply giving full particulars of age, qualifications and experience to Box No. 7663, Electrical Times. (N 598)

TWO ASSISTANT ELECTRICAL ENGINEERS required by large firm Architects Central London. H.N.C. or O.N.C. standard only. Apply giving personal details, education, experience, salary required.—Box No. 7635, Electrical Times. (N 493)

TECHNICAL SALESMAN with established connections in London and Home Counties required for sale of overhead and rising busbar systems. Write to Marryat and Place Ltd., 40 Hatton Gdn, E.C.1. (N 503)

BUSINESS OPPORTUNITIES

ELECTRICAL ENGINEERING AND WIRING CONTRACTOR (Estd. 30 years) invites another interested Contractor or Experienced Engineer to take charge of all outside work (Central Essex Area) with a view of taking over the Stock-in-Trade and Goodwill in the near future. For particulars apply Box No. 7679, Electrical Times. (N 655)

PATENTS

THE Proprietors of Patent No. 717519 for "Improvements in or relating to High Frequency Variable Inductances" desire to secure commercial exploitation by Licence or otherwise in the United Kingdom. Replies to Haseltine Lake and Co., 28 Southampton Bldgs, Chancery La, W.C.2. (N 610)

THE Proprietors of Patent No. 659801 for "Improvements in or relating to a Coil Assembly" desire to secure commercial exploitation by Licence or otherwise in the United Kingdom. Replies to Haseltine Lake and Co., 28 Southampton Bldgs, Chancery La, W.C.2. (N 611)

THE proprietor of British Patents Nos. 741103 and 741443, both entitled "SNAP ACTING THERMOSTAT," offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 E. Jackson Blvd., Chicago 4, Illinois, U.S.A. (N 654)

WORK WANTED

A.C. and D.C. MOTOR REWINDS and REPAIRS. Prompt service, fully guaranteed. Edgware 5566 (4 lines). — Service Electric Co. Ltd., Stanmore, Middx. (N 2)

WANTED

WANTED for prompt cash, ferrous and non-ferrous SCRAP; also plant for dismantling. Buyers of second-hand machinery and plant for re-use.—W. and H. Cooper Ltd., 17 Brady St, Bethnal Green, E.1. (N 1)

FOR SALE

A. J. PRATT & SONS LTD.

THE CHAIN SPECIALISTS

Chains in Brass, Steel, Aluminium and Gilding Metal. Coil, Jack, Ladder, Oval, Trace, Curb, Chandelier, Ball, Victor, Fancy Chains and all Types of Chain Assemblies in every finish. Hooks, Rings, Wireforms, Presswork.

Head Office: Chain Hse, Woodbridge St, London E.C.1.

London: CLErkenwell 3742 (2 lines).

(N525)

LITTLE USED ELECTRICAL EQUIPMENT

1. One 30 kVA Ferranti transformer, *Primary*, 4/5 V 3 phase 50 C, 41·8a delta.
   Secondary, 230/133 V, 50 C, 75·3a star fitted with Ellison 40/60 circuit breaker.
2. One 6 way 500 V, 20 A T.P. fuseboard (Bill).
3. Five 15 A T.P. Switches (Bill) and 3 pin sockets (Nypham). Three 15 A and two 5 A.
4. One 15 A D.P. switch fuse.
5. Quantity 1¼" enamelled conduit with fittings and cables as fixed.

The whole is mounted on the wall of an outhouse at a Territorial Army Centre in Handsworth, Birmingham, and the purchaser will be required to dismantle and remove. Enquiries to:

Secretary, WARWICKSHIRE T. & A.F.A., 28 Jury Street, WARWICK

(N 626)

A.C. and D.C. SLOTMETERS: Time Switches and Quarterly Meters. Single and polyphase, 2½—100 amps. Tested and guaranteed 2 years. Television and Billiards Meters. — Tradex Meter Co., Surbiton. Elmbridge 4487. (N 9)

A.A. ELECTRICAL CO. for A.C.-D.C. MOTORS, switchgear, exhaust fans, hoists, reduction gears, new or reconditioned units.—Chi 5105, 67 Rothschild Rd, W.4. (N 3)

A.C. and D.C. MOTORS, GENERATORS from stock.—Service Electric Co. Ltd., Honeypot La, Stanmore, Middx. Edgware 5566/9. (N 4)

CABLE.—A large quantity of Admiralty pattern, single-core, 1,109/·028 C.T.S. flexible cable in first-class condition.—Box No. 7685, Electrical Times. (N 666)

FOR LIGHTING GLASS, contact Stevens and Williams Ltd., Tipton, Staffs. Anything in Opal, decorated, pressed or blown, for domestic, commercial and street lighting. Largest exclusive lighting glassworks in the world. Buy British. (N 12)

FOR SALE.—Three-Phase Artificial Convertor comprising two Westinghouse 4 kVA Units, £100.—Moores Weybridge Ltd., Monument Hill, Weybridge, Surrey. (N 621)

ELECTRIC MOTORS, D.C. and A.C. Motor Generator Sets, Alternators and Dynamos, Diesel Sets, Circuit Breakers, Switchboards, reconditioned and guaranteed. Very large stocks held.—Britannia Manufacturing Co. Ltd., Britannia Walk, N.1. CLErkenwell 5512-3-4. Stores at Chobham, Surrey. (N 7)

HOUSE-SERVICE METERS, all types can be obtained by return from Selectric, Dept. E.T., Meter Hse, Factory Row, Castle Circus, Torquay. Phone 7218. (N 8)

HOUSE-SERVICE METERS, A.C. or D.C., quarterly or prepayment.—Universal Electrical, 221 City Rd, London E.C.1. (N 5)

PURLEY CHOKES AND BALLASTS. Our 80-W tapped h.p.f. ballast with starter switchgear-holder incorporated is proving itself the most popular unit. Suitable for most fittings, 57s 6d each subject. —F. W. Blanshard Ltd. (Dept. E.T.), Purley, Surrey. Uplands 4818/9. (N 6)

SECOND-HAND Electrical Plant can be as good as new if you buy it from specialists. Write for our stock list. Dynamo and Motor Repairs Ltd., North End Rd, Wembley Pk, Middlesex. Telephone: Wembley 3121; Soho Rd, Handsworth, Birmingham. Telephone: Birmingham Northern 0898. (N 11)

50 kVA GENERAL MOTORS, 27½ kVA and 187 kVA Generating Sets. B. G. Plant (Sales Agency) Ltd., Watlington, Oxon. Watlington 44. (N 612)

INDEX TO ADVERTISERS

Acme Electric Manufacturing Co. (Tottenham) Ltd., The 62
Associated Electrical Industries Ltd. (Cable Division) ... ... *Cover* (i)
Associated Electrical Industries Ltd. (Motor & Control Gear Division) ... 38
Associated Electrical Industries Ltd. (Transformer Division) 42
Associated Electrical Industries Ltd. (Instrumentation Division) 47
Associated Electrical Industries Ltd. (Electronic Apparatus Division) ... 59
Atlas Lighting Ltd. 17

Babcock & Wilcox Ltd.... 15
British Driver-Harris Co. Ltd. ... 37
British Klockner Switchgear Ltd. ... 58
Brookhirst Igranic Ltd. 57
Brook Motors Ltd. 5
Bullers Ltd. 18

Central Electricity Generating Board... 23
Channel Conduits Ltd. 45
Chilton Electric Products Ltd. ... 11
Contactor Switchgear Ltd. 45
Crompton Parkinson Ltd. ... 21, 64

Donovan Electrical Co. Ltd. 48
Dowling, David, Ltd. 62
D.S. Plugs Ltd. 6

Electric Construction Co. Ltd. ... 40
Electro Dynamic Construction Co. Ltd. ... ... *Cover* (ii)
English Electric Co. Ltd. ... 27, 34, 35
Erskine, Heap & Co. Ltd. 2
Evershed & Vignoles Ltd. 4
Expanded Metal Co. Ltd., The... ... 20

Ferranti Ltd. 29

General Electric Co. Ltd. ... 9, 33, 61
Genristo Ltd. 62
Gent & Co. Ltd. 8

Hackbridge Cable Co. Ltd. 32
Hawker Siddeley Group 3
Higgs Motors Ltd. 10

Imperial Aluminium Co. Ltd. ... 12, 13

Lock, A. M., & Co. Ltd. 60
London Electric Firm Ltd. 58
London Electric Wire Co. & Smiths Ltd. 36

Marryat & Place Ltd. 22
McArd, Robert, & Co. Ltd. 22
Mersey Cable Works Ltd. 41
Metway Electrical Industries Ltd. ... 7
Midland Electric Manufacturing Co. Ltd. 39

Oddie, Bradbury & Cull Ltd. 30
Otter Controls Ltd. 56

Parmiter, Hope & Sugden Ltd. *Cover* (iii)
Permali Ltd. 63
Pitman, Sir Isaac, & Sons Ltd. 30
Press, Wm., & Son Ltd.... 14

Reyrolle, A., & Co. Ltd. 44

Salter, Geo., & Co. Ltd. 19
Scottish Cables Ltd. 31
Sheen (Nottingham) Ltd. 30
Simmonds & Stokes (Niphan) Ltd. ... 22
Simplifix Couplings Ltd. 28
Square D Ltd. 16
Sturdy Electric Co. Ltd. 45

Taylor, Tunnicliff & Co. Ltd. 24
Thompson, J., Water Tube Boilers Ltd. ... ... *Cover* (iv)

Walsall Conduits Ltd. 1
Wandleside Cable Works Ltd.... ... 46
Whiteley, B. S. & W., Ltd. 7
Wootton & Co. Ltd. 60

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They've got to be **GOOD** to be **here**

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The simplest and most reliable of *all*. They PRESS their contacts together to open them with a SNAP!

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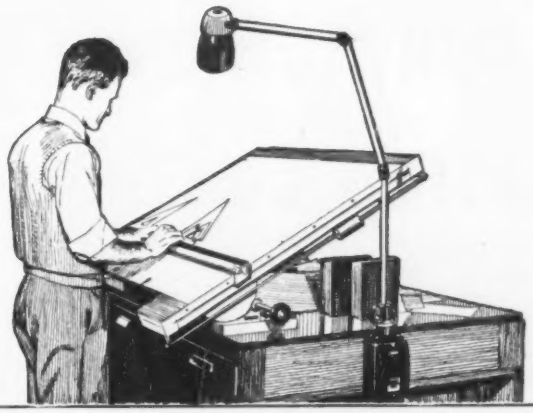


Newly designed to be:

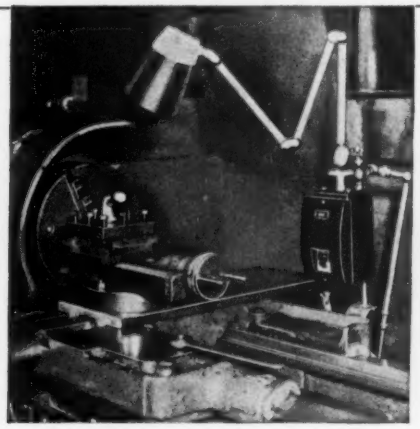
- ✳ **smaller and more powerful**
- ✳ **safer than ever**
- ✳ **versatile in application**

The 100-watt Lo-vo-lite transformer unit now measures only some 6 x 4 x 4 in.

New patented joints and spring counterbalancing ensure steady, accurate Lo-vo-liting of the work.

Either one or two output leads for portable lamps can be provided for at the sides or top of the transformer.

The transformer box can have a strong carrying handle.



The transformer can also be built-in to a machine: the arms and shade can be mounted on wall, bench or machine remote from the transformer.

Two lengths of arm give a choice of six combinations— 24, 27, 30, 33, 39 or 45 in. overall arm reach.

The Lo-vo-lite self-isolating feature, and the choice of low output voltages, make Lo-vo-lite utterly safe.

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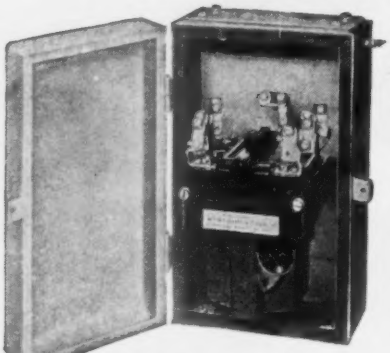
BKS

CONTACTORS

for

HEATING CONTROL

or similar non-inductive loads



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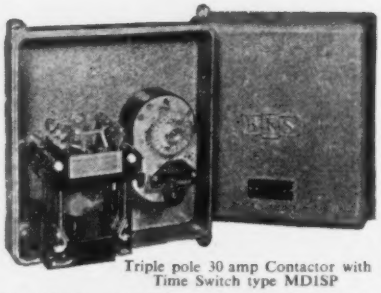

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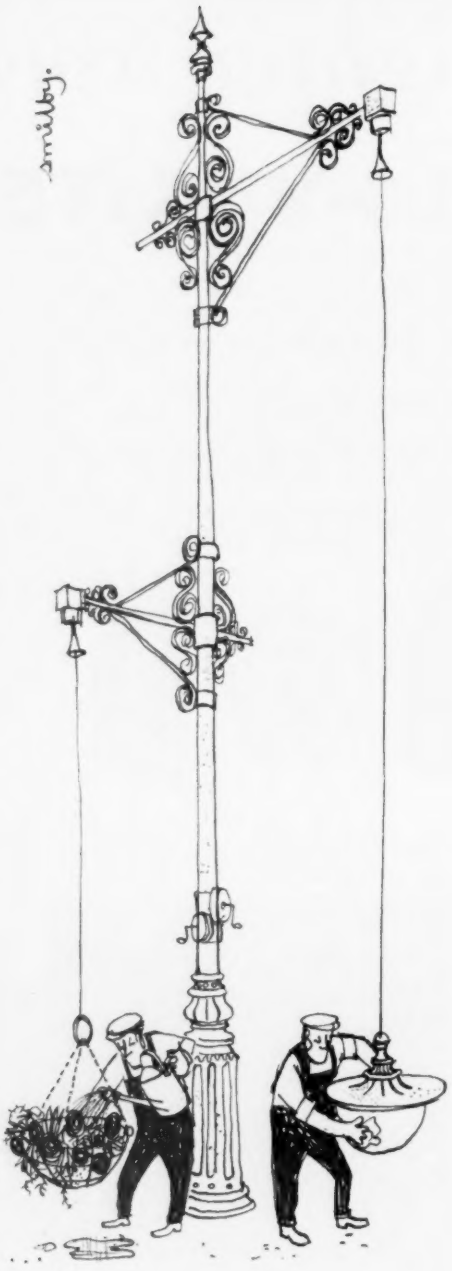

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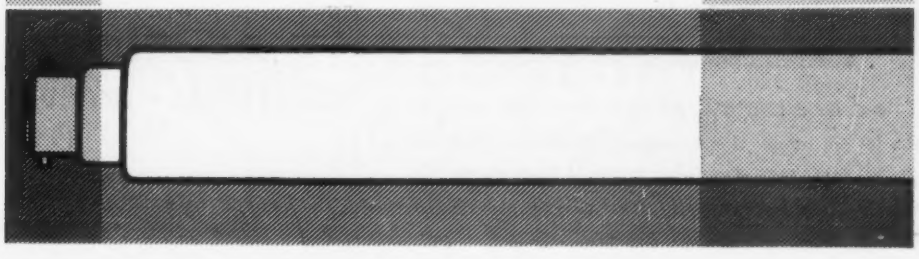

Bowl fire elements
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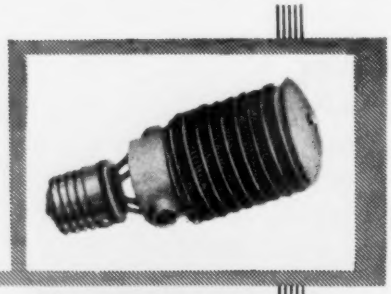

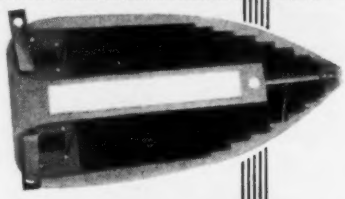

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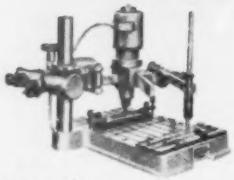

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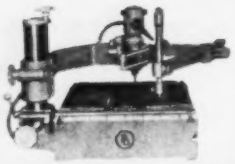

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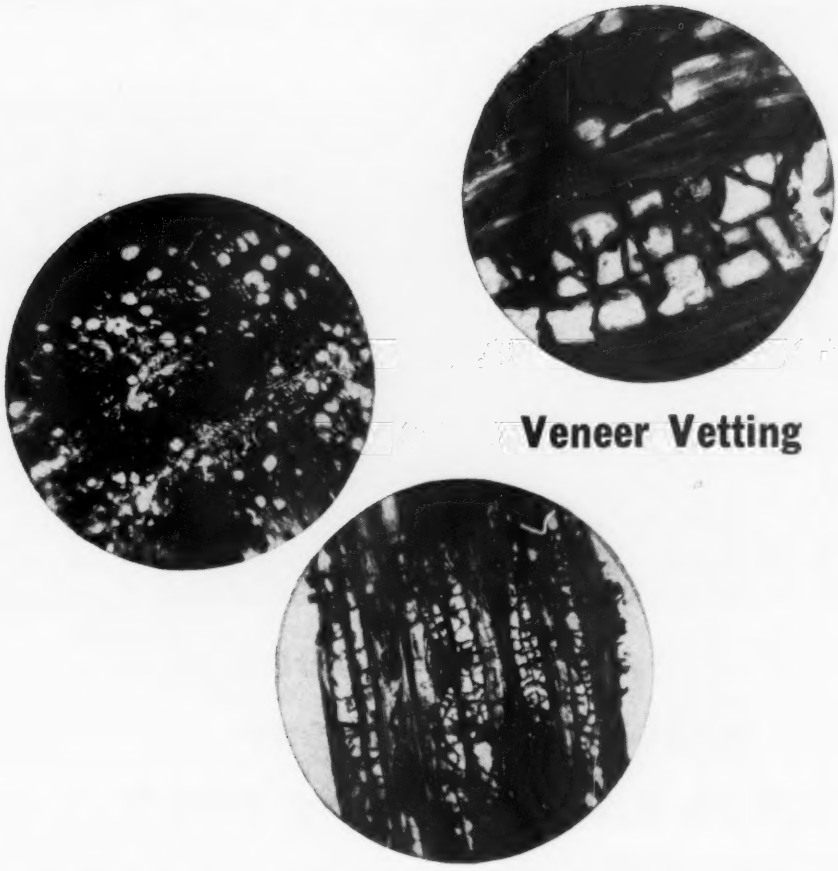

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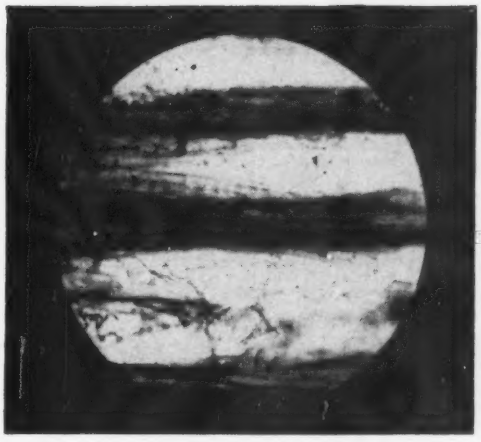

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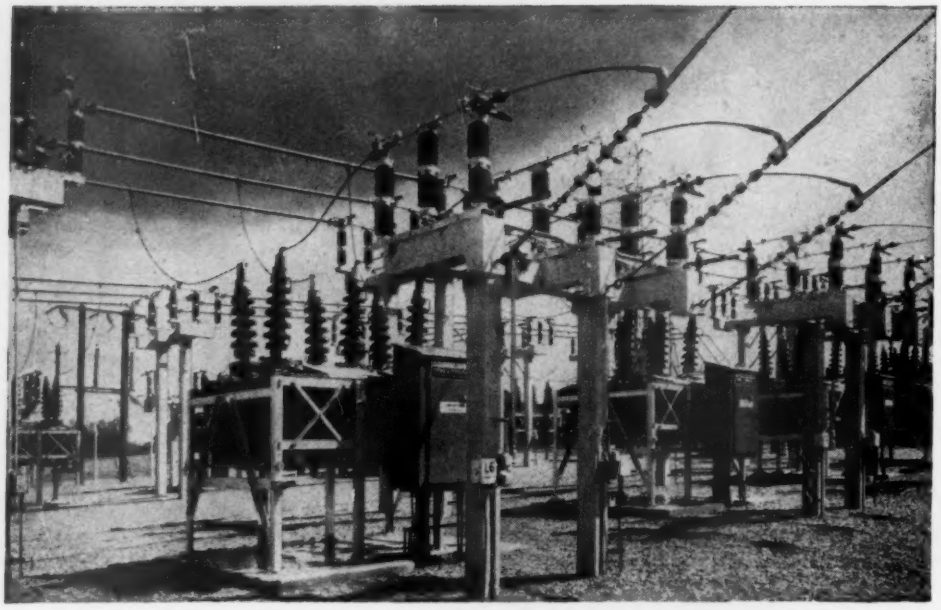

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CABINET STYLE DISTRIBUTION BOARDS

Widespread acceptance of surface mounting Fluvent Cabinet Style Boards has resulted in the production of Switches of similar exterior, intended principally for use as control switches mounted in conjunction with the boards. Both boards and switches have pressed steel cabinets which are cadmium plated and painted to give a grey metallic hammer finish.

The range has been further reinforced by the production of boards for recessed mounting, illustrated right. They are designed to allow the main body of the board to be sunk into a wall cavity of appropriate depth; the plasterwork and wall finish are then made up to the surrounding surface plate provided.

Aeroflex

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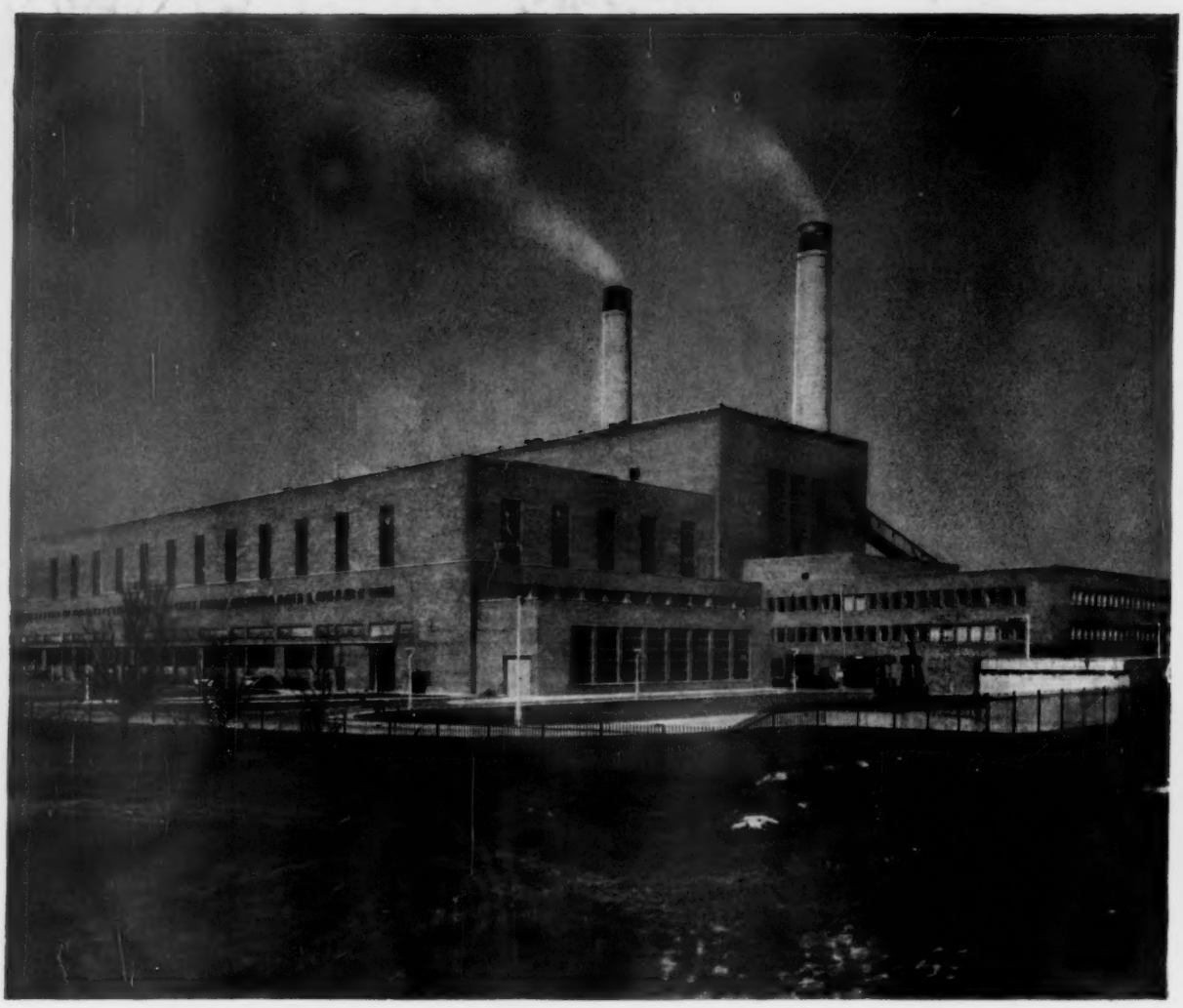

"Etaflo" Water Tube Boilers at Tilbury

For the Central Electricity Generating Board's power station at Tilbury, John Thompson have supplied 6 pulverised fuel "Etaflo" boilers of 60 M.W. These boilers are arranged for alternative oil firing.

Boilers of the same type are in operation at Brimsdown, Marchwood and Bold power stations. Work is now in progress on the Central Electricity Generating Board's contract for Richborough incorporating two "Etaflo" boilers of 120 M.W.

Consulting Engineers for Tilbury: Merz & McLellan

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